THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXXI. No. 1823.] LONDON, APRIL 19, 1898. [50TH YEAR. PRICE 6d.

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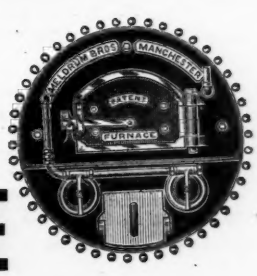

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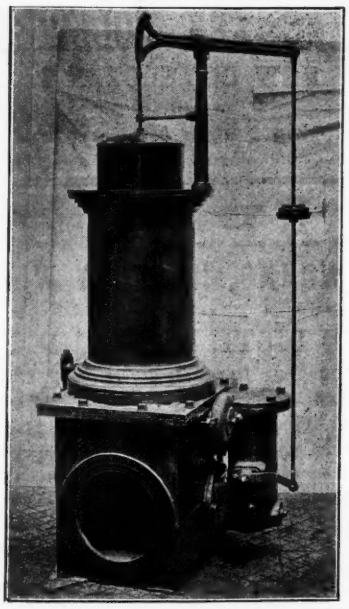

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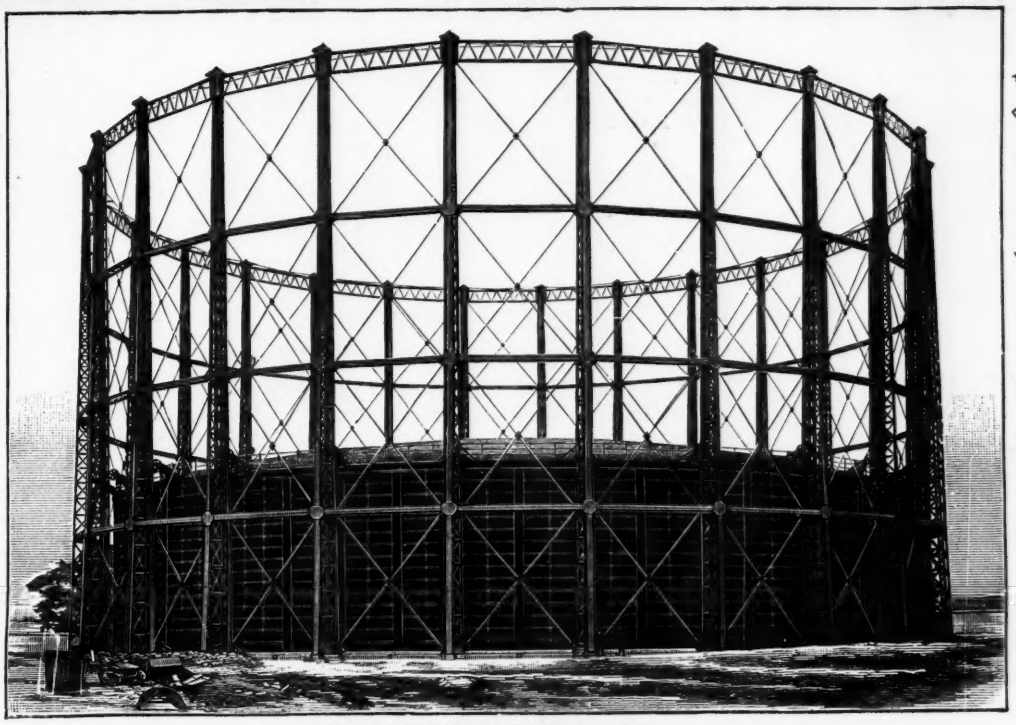

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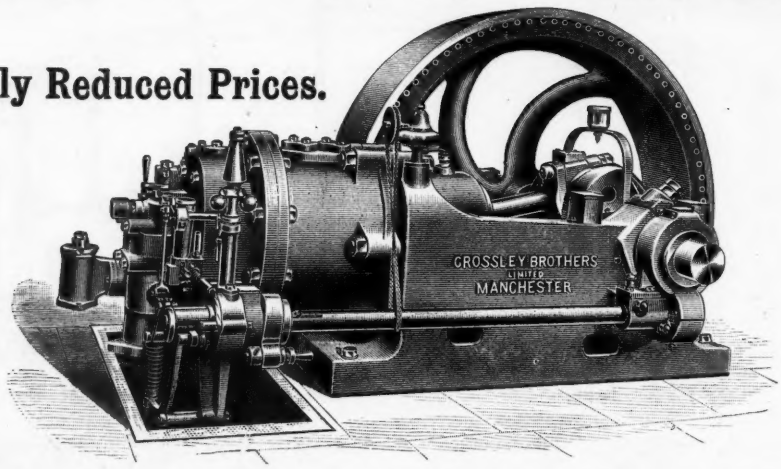

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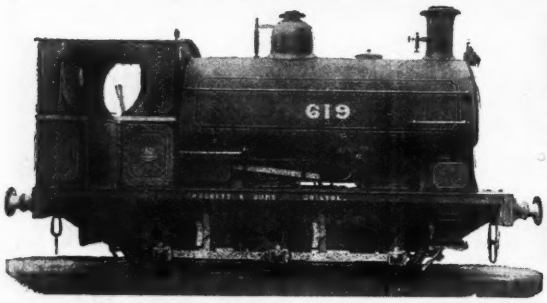

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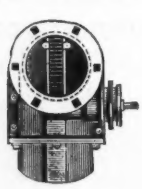

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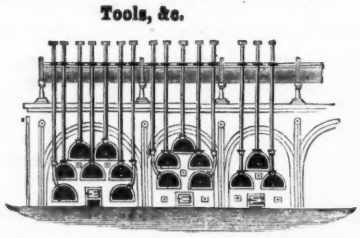

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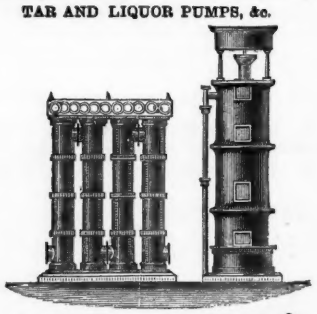

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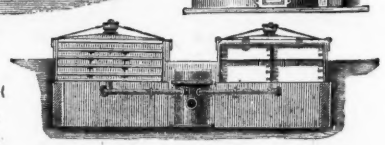

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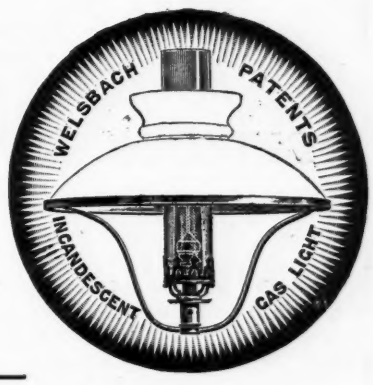

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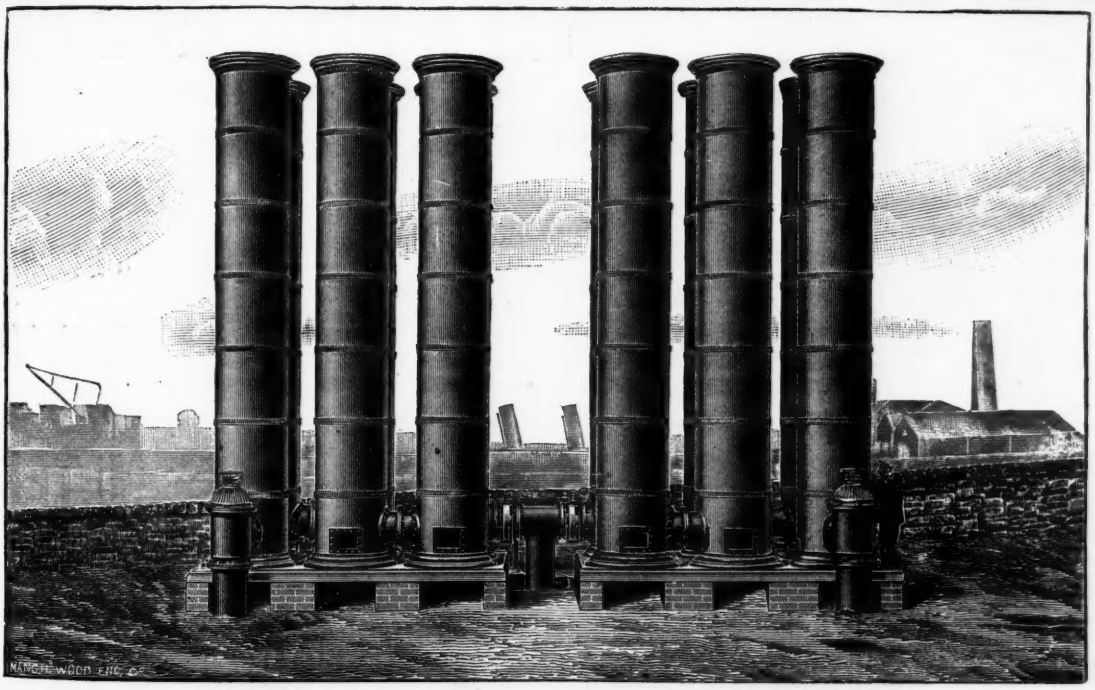

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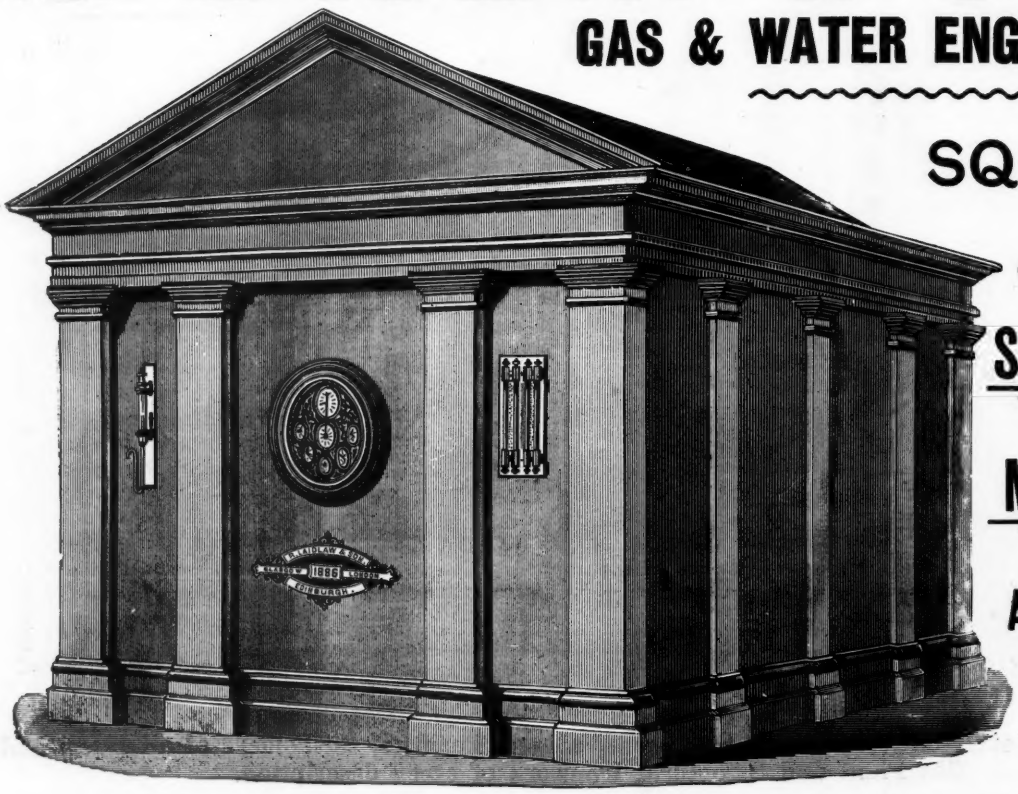

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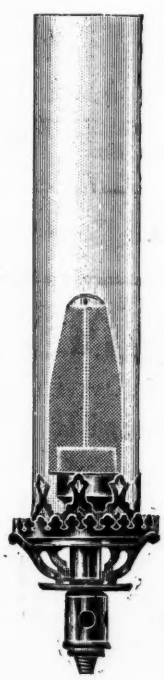

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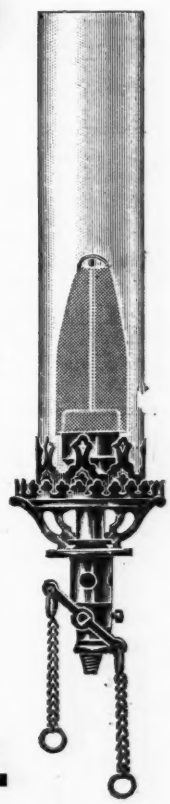

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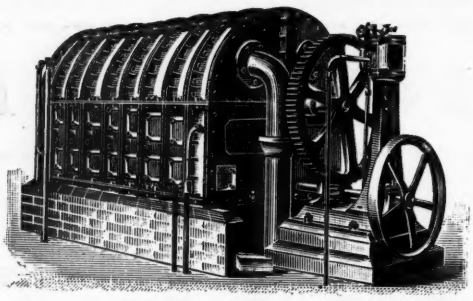

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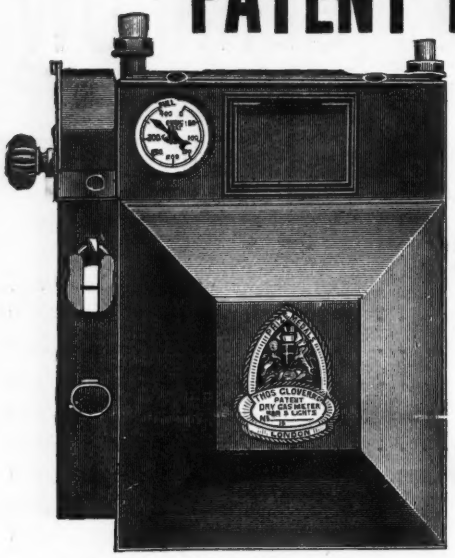

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TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

All communications, remittances, &c., to be addressed to WALTER KING, 11, BOLT COURT, FLEET STREET, LONDON, E.C.

EDITORIAL NOTES.

The Reply of the Directors of The Gaslight and Coke Company to Mr. G. Livesey.

THE last ordinary general meeting of The Gaslight and Coke Company was held on Feb. 4. It was signalized by the delivery by Mr. George Livesey of perhaps the most serious indictment of the administration and management of a great Gas Company that was ever heard in a shareholders' meeting. We remarked at the time that, whether regard were had to the publicity of the occasion, the gravity of the matter, or the authority of the speaker, the importance of the proceeding could not be gainsaid. It is safe to say that every reader of the "JOURNAL" containing the report of that meeting recognized that the incident was of sufficient seriousness to constitute an epoch in the history of the Company. Everybody asked naturally what the impeached directorate and management would do in the circumstances. There is a formal difficulty in bringing an attack upon the Directors of a Company to an immediate practical issue by any means short of moving an amendment to the usual motion in favour of the reception of the report and accounts. For reasons which may be divined, Mr. Livesey was not prepared to follow this course. But the inevitable consequence was that he had no regular alternative; and his suggested appeal to an informal court of inquiry was ruled out of order. The meeting consequently ended without anything transpiring to show what action, if any, the Board meant to take. Two months passed without a sign to indicate that the Horseferry Road did not mean to take Mr. Livesey's onslaught "lying down;" and then, on the eve of the Easter holidays, the incriminated establishment in question put forward a reply in form.

It would be impolite to attempt to dispose off-hand of a statement that has been so long in preparation. There is no fault to be found, at any rate, with the manner in which the Chartered Board have faced their redoubtable critic. They reproduce from our columns the full text of Mr. Livesey's speech, carefully dividing the various counts of the indictment by cross-headings. It is unnecessary to recapitulate these points; but it may be as well to note that they are further divisible into matters of fact and questions of opinion—the classification, however, being by no means of a hard-and-fast character. This consideration comes out in regard to the first point taken up in the "Reply," which is as to the character of the district of The Gaslight and Coke Company. Is this the best in the world, or is it not? To bring the comparison down to a narrower basis, which is the more profitable district—that of The Gaslight and Coke Company, or that of the South Metropolitan Company? In essaying to show that their inheritance is, on the whole, not so desirable a one as that of the southern Company, the Directors for the first time confess that the competition of the electric light has hit the undertaking very hardly. After reading this part of the "Reply," one wonders the more why the Directors chose the particular time they did for relinquishing those meter-rents which might at least have paid the expenses of the visiting inspectors. It may be said at once that reference to the division "Meter-Rents" farther on does not lighten the mystery. The Chartered Directors adduce, among the drawbacks of their "unrivalled" district, the facts of a "specially large area" of it being paved with wood or asphalte, thus making service laying costly; and of the testing-stations being at the same time numerous and scattered over a great deal of ground. They adopt the view of the late Chemist to the London County Council, expressed in 1894, that "the gas supplied by the South "Metropolitan Company is most inadequately examined." These rejoinders, which are dealt with by Mr. Livesey in a letter which appears in our "Correspondence" column, do not strike one as being particularly well founded, not to say convincing.

Next comes the subject of residuals; and very early in their "Reply" we find the Directors complaining, in the old familiar querulous tone, of their "disingenuous critics." In all this part of the official statement, no admission is made of the fact that the Company do more to work up their residuals than the other London Gas Companies, and therefore ought to make more profit by them. The bulk of the matter consists of charges of inconsistency in counsel levelled against Mr. Livesey, which do not advance the question. Certainly, this is a part of the "Reply" which

possesses little general interest. There is, indeed, altogether too much of the *tu quoque* method in the whole statement. For this reason we think the proprietors, to whom it is addressed, will be unable to make head or tail of it. For instance, when protesting against Mr. Livesey's "exaggerated language" in describing the recent increase in the price of the Company's gas as "a very disastrous "thing to do," the idea of the "Reply" is that, since the South Metropolitan Company did the same thing in 1891, there is nothing more to be said. Again, when it suits these apologists, they can plead the example of other Companies. When this course does not suit them, they urge that the circumstances of their undertaking are so *very* different from all others that any comparisons made would only mislead!

It is to be feared that the critics of the Horseferry Road Administration will only rejoice over the official explanation of the cause of the difference between the selling prices of gas north and south of the Thames. To the charge that the Company's carbonizing wages are excessively high, the "Reply" finds it the most telling response that those of the Crystal Palace District Gas Company are worse! But we do not think it profitable to follow this string of "feline amenities" to the end, which is as the beginning. We did not adopt—we were careful not even to repeat in this column—Mr. Livesey's original charges; and therefore cannot be accused of partiality in leaving the "Reply" to stand for itself. It was impossible to deny the strength of Mr. Livesey's attack, whatever might have been thought of its timeliness or intention. Unhappily, without going into details, or making overmuch of the personal direction of the "Reply," it does not convey the impression of a defence which is likely to serve the Company well either in Parliament or before the bar of public opinion. Surely, there should be something better to be said for the Company than this laborious exercise in recrimination, so empty of anything like virility that nothing more is needed to justify the expert criticism which has so impeached the capacity of the Administration. The Directors had far better have kept silence, if this is the best answer they could work up in two months. It will be some time before they will hear the last of this apology for their existence as a Board.

The Working Results of the London Gas Companies.

On another page will be found particulars, in our customary form, relating to the working of the London Gas Companies in the past year. It is the drawback to statistics of this kind that they are bound to follow the accounts to which they refer, so that in giving the total capital returned by the different Companies as sunk in their undertakings, the converted and consolidated capital of the South Metropolitan Company has to appear as if it was still upon the same footing as the unaltered capital of the other Companies. There is no cure for this confusion, which vitiates many previously fair comparisons and inferences. The incomes of the different Companies exhibit the usual features. In respect of cost of gas making per ton of coal, the Chartered result is considerably higher than that of the other Companies, which is as curious a fact as ever it was, notwithstanding all explanations and apologies. The raw materials, coal and oil, cost the Commercial Company 11s. 8·45d. per ton as against the Chartered 11s. 1·82d. per ton and the South Metropolitan 10s. 4·22d. per ton. Salaries and wages for gas manufacture follow the same order—the Commercial having a slight lead, with 3s. 8·53d. per ton, while the Chartered figure is 3s. 8·21d. per ton, and the South Metropolitan 2s. 6·04d., to which should be added perhaps 6d. per ton (from the entry for bad debts and extraordinary expenses) to cover profit-sharing expenditure. Altogether, the table as it stands shows the Chartered Company spent £1 4s. 5·23d. per ton of coal (and oil), while the Commercial Company expended £1 2s. 9·55d., and the South Metropolitan £1 1s. 8·83d.

The table showing the increases and decreases in each item of the revenue accounts for 1897 as compared with 1896 exhibits some figures that will be esteemed comforting by the friends of the gas industry. Thus it is a pretty good sign of the continued vitality of this industry in London, despite the endeavours and assertions of its rivals and detractors, that the Companies had an increase of gas-rental for the year of nearly £220,000. Quite the usual ratio of increase was maintained in the receipts for public lighting, which were nearly £3000 more. The rents of gas stoves and meters rose £13,466. Residuals, on the other hand, the trade in which is influenced by other considerations than that of the comparative popularity of different kinds of artificial lights, went down in value £73,180 although there was more to sell. All the Companies had to pay bigger bills for raw materials; but the Chartered increase of £10,508 in carbonizing wages is abnormal. The South Metropolitan Company made a big effort in works restoration out of revenue. To put the totals in a succinct way: It cost the Chartered Company an additional £71,467 to earn their increase of £73,149; the Commercial increase of £19,479 cost £15,038; and the South Metropolitan increase of £72,081 cost £67,956.

The carbonizing results which are given below show some changes from those of past years. The disturbance introduced by the manufacture of oil gas and the extensive use of petroleum spirit for carburetting prevents exact any comparison of one year with another; but it is remarkable to find the South Metropolitan production coming so nearly on an equality with that of the Chartered. Circumstances appear to have altered cases here.

Table *showing the Residuals produced per Ton of Coal and Cannel, and the Gas made per Ton of Coal, Cannel, and Oil, by the Metropolitan Gas Companies in the Year* 1897.

Name of Company.	Coke.	Breeze.	Tar.	Am. Liq.	Gas.
	Cwt.	Bushels.	Gallons.	Gallons.	Cub. Ft.
Chartered	12·26	3·54	10·38	29·93	10,447
Commercial	12·13	3·07	10·25	36·38	10,285
South Metropolitan	12·32	4·40	9·76	33·11	10,136
Mean per Ton	12·26	3·75	10·19	31·32	10,348

Concerning Sliding-Scales.

It is more than passing strange that at the present moment the validity of the arrangement known as a "sliding-"scale" should be at issue in disputes of two very different kinds. In the case of the agitation against the increase in the price of gas in North London, the popular complaint is that the sliding-scale of price and dividend has not operated to keep the management of the Gas Company up to the best contemporary standard. In South Wales, the colliers' complaint is that their sliding-scale of coal prices and wages no longer works satisfactorily to themselves. It is evident that in contemplating a sliding-scale, to whatsoever purpose applied, criticism may be addressed to at least two aspects of the subject. One is the function and operation of the sliding-scale itself; the other is the efficacy of the particular example under notice—which again is mainly conditioned by the datum, or initial point, and the adjustment of the two limbs of the scale with reference to the initial and to each other. Really, all mercantile and industrial operations are carried on under an unwritten economic law, which is a sliding-scale. When, in the course of a couple of centuries, the retail price of a pound of tea is reduced from 20s. to 1s., while the aggregate profits of the tea merchants are larger at the cheaper than they were at the dearer price, this is due to the operation of a natural sliding-scale. All commercial expansion is fostered by prompt recognition of this principle. The merchant who sees his own advantage in reducing the price of his wares is, all things being equal, the prosperous trader as compared with him who cannot afford to cut prices because his own profit amounts to so little. Thus there is complete justification for the prescription of an artificial sliding-scale for the regulation of those industrial or commercial operations in which, for any reason, the action of the natural principle is sluggish. The science of political economy is largely the history of sliding-scales, as well as of the failure of all other devices for increasing the supply of commodities and reducing their price.

It is unnecessary to discuss afresh here the by no means agreed subject of the justification for the introduction of the sliding-scale into British gas legislation. For twenty years and more this artificial reproduction in the British statutory gas industry of the acknowledged rule of the open market has been in operation, and with the tacit approval of the community. The British public used to believe in the sovereign virtue of competition in gas supply, as the American public does to this hour. The former, however, has learnt that competition in trade is only one means whereby the great principle of the sliding-scale of price and profit may be speeded up and developed

to its full capacity. Different industries and services require different means for the realization of the same principle. The actual principle has been materialized, on a certain basis, in the gas industry; but not with invariable success. Perhaps too much is expected of it. After all, a sliding-scale of profit and price, whether natural or artificial, cannot be productive of either wise administrative counsels or good shop and works management—else there were fewer bankruptcies. Bankruptcy is the ordinary commercial means for the elimination of the unfit in business. Our statutory transport and public service undertakings are protected from any such extreme punishment for the misfortune of getting temporarily into inefficient hands; but a good equivalent for this means of purgation is still to seek.

With regard to the sliding-scale in the Welsh coalfields, "The Times" describes the operation of the plan in words that might almost be applied directly to the sale of gas: "The South Wales coal trade has been regulated, it is "hardly necessary to remind our readers, for over twenty "years by what is known as the 'sliding-scale.' By this "system, which was devised to avert a repetition of the "loss and sufferings incidental to the great strike of 1875, "the rate of wages rises and falls automatically in proportion to the price of coal." It is a simple translation into an exact formula of the natural relations of the coal and labour markets; and the only practical question concerning it, in the estimation of those who have accepted the plan, is as to the justice of the datum. Dissatisfaction with the initial point obviously casts no discredit on the principle; and in the case of most sliding-scales, it has been found expedient to make more or less arbitrary adjustments, or to leave margins from time to time for the sake of preserving the peace. The South Wales dispute has been a deplorable disturbance of the development of trade at a critical period; but we cannot believe either that it will last long or prove a permanent breach in the sliding-scale method of adjusting local wages to prices.

The South Wales Coal Strike.

Since the time, in the early days of the trouble, when we referred in these columns to the brooding unrest in the South Wales coalfield, matters have gone from bad to worse in this region, until at the present moment the steam coal trade of these parts is to a very large extent paralyzed by a strike of the miners. How long the disturbance will last, or what will be its effects upon the coal trade of other parts of the country, cannot be stated with any degree of reliability. We are not disposed to magnify either the dispute or its possible consequences. There has been no strike in the South Wales coalfield for upwards of twenty years; and the men have done all this time without a Union or a war fund. It is to be feared that the present revolt of the men against the sliding-scale arrangement by which their wages were adjusted to the price of coal, is a result of socialistic suggestion, and a triumph of professional Trade Union plotting from without. Although the Welshmen have on more than one occasion declined, not too courteously, to be "led" by the professional gentlemen from the Miners' Federation districts who are so experienced in this kind of thing, they seem to have succumbed at last to the foreign charms of the "living wage," the "limitation of the output," and other Trade Union fetishes. The strike began in the usual way, with the refusal of the men to continue at work under the established conditions. Then came the plea that the old scale of wages was "starvation" for the men; and this was followed by the usual abuse of capitalists and all their works. At the first alarm, the principal coalowners, already associated for the purpose of administering the sliding-scale agreement, drew closer together, and thus presented a firm front to the malcontents. A curious feature of this outbreak is that the men and their old employers are at loggerheads over one of the leading points of Trade Unionism. It is the employers who wish to treat with, and repose faith in, the regularly-appointed leaders of the men; while the men are in open revolt as much against their old leaders as against the employers. This being the case, the employers, whose anxiety to meet their hands amicably has never been in dispute, have very naturally stipulated that the delegates, or representatives, or whatever may be the proper description of the strikers' agents with whom they are to treat in conference, should be invested with plenary powers to consent to a settlement. The record of past strikes shows the futility of attempting to deal with go-as-you-please delegates, who assert or shed their authority just as it suits them. For the moment the men appear to be unable to make up their minds on the question whether they can find representatives whom they can trust to negotiate in their interest with the employers. Hence there is a deadlock, which the employers are turning to account by publishing wages-sheets to show that competent pitmen had been earning from 8s. to 10s. per day on the old "starvation" scale of wages. The men have appealed for funds to other mining centres of the United Kingdom; and much will depend on the response to this application.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 599.)

On the resumption of business on Tuesday, after the Easter vacation, the week opened gloomily enough; and it continued to the close oppressed with the one and only question: Can war be avoided? As day succeeded day without developing any trustworthy sign of the solution, so business remained in a state of suspense. The position was extremely sensitive; and no one dared to make a venture. One good thing was that the fortnightly account was small; and no difficulties in adjustment were developed. Of course, prices are down throughout the list; and in the condition of things the choicest gilt-edged stuff has suffered as much as any. The Money Market was easy, although there was some talk of the chance of a rise in the Bank rate on Thursday; and the Stock Exchange did not require much accommodation. But if war is declared, a rise would be almost inevitable. Business in Gas was, on the whole, only moderate; and although the week opened with a show of briskness, the rate of action could not be maintained. Movements were slight, and changes in quotation were capricious and irregular. In Gaslights, the "A" opened with a great show of firmness, and gained a couple of points on Monday, and one more on Tuesday, with business marked at 286½. But the pace was too good to last; and the quotation had to come back a little. From this point, however, it held steady to the close. In recent public discussions concerning the Company, nothing is so remarkable as the extraordinary ignorance of the subject displayed by some speakers. Such meetings must be unprofitable, if not mischievous. Some moderate business was done in South Metropolitan. But the price was not good; and the quotation went back a point. Hardly anything was done in Commercials. On *ex div.* quotation, the old stock was set back; but the new remained steady. Scarcely anything was done in the Suburban and Provincial Companies; and quotations stood unchanged. The Continental group were extremely quiet. Imperial and Union were steady; but European fully paid receded half a point. Among the rest, a slight setback in Buenos Ayres was the only feature. In Water there was scarcely any business at all; some half-dozen transactions in debenture issues being about the sum total.

The daily operations were: Transactions in Gas were fairly active upon the reopening of the market on Tuesday. Gaslight "A" was strong, and rose 2. Business fell off exceedingly on Wednesday. But the tendency remained just as firm; and Gaslight "A" advanced 1 more. There was a little recovery in business on Thursday in point of volume; and prices on the whole were very fair; but Gaslight "A" lost the point it had been advanced the previous day. Friday was another quiet day; and the tendency was not so good. South Metropolitan receded 1; European, ½; and Buenos Ayres, ¼. Saturday's business was of the usual light order; and quotations closed unchanged.

THE RELATIVE ACTIVITY OF BOG OXIDE AND WELDON MUD AS PURIFYING MATERIALS.

We have endeavoured to show, in recent numbers of the "Journal" (*ante*, pp. 337, 582, 643), the thermic effects which accompany the fouling and revivification of bog oxide and Weldon Mud, when these materials are used under comparable conditions for the purification of coal gas. The vigour with which the actions proceed, may be fairly gauged by the magnitude of the thermic effects; and hence observation and computation of the latter have a practical, as well as theoretical, interest. Observation of a sufficiently comprehensive and precise description is wanting; and we have therefore had to fall back on computations from the best available thermochemical data for the figures given for the thermic effects in both cases. Though, for several reasons, these figures cannot be regarded as exact, yet the error, whatever its magnitude, will be virtually the same for both materials; and therefore for purposes of comparison the figures may be accepted without misgiving. We now propose to make a few observations with

regard to the intrinsic merits of bog oxide and Weldon Mud, and shall use the figures arrived at in the articles already referred to as the basis of our arguments.

In the first place, bog oxide has an initial advantage in that, in the state in which the new materials would be put into the purifier, it contains a larger percentage of the active ingredient. Thus bog oxide containing 50·34 per cent. of anhydrous ferric oxide is apparently a better purifying agent than Weldon Mud containing 34 per cent. of manganese dioxide. Complete fouling of 100 parts of the oxide is accomplished by 32·09 parts of sulphuretted hydrogen; whereas the same quantity of Weldon Mud will be completely fouled by 26·6 parts of sulphuretted hydrogen. For every 100 parts of material in the purifiers, 1075 parts (by weight) of purified gas will be obtained in the case of oxide, and only 890 parts in that of Weldon Mud. Therefore 100 parts of bog oxide should purify 185 parts of gas more than is purified by 100 parts of Weldon Mud. The issue can be made clearer by stating a concrete case. For every pound of each material of the composition which we have taken as representative put into the purifiers, 290 cubic feet of purified gas should be obtained in the case of oxide, and 240 cubic feet in that of Weldon Mud. That is to say, for every pound of material, oxide should purify 50 cubic feet more gas than Weldon Mud purifies. These statements have a substantial basis, for they rest on well-established chemical data, and are independent of thermal considerations. If practical results do not bear them out, we are forced to the conclusion that some part of the ingredient on which the activity of the material depends is physically inaccessible to the sulphuretted hydrogen in the gas; and that therefore the purifying capacity of the material is diminished. If this be found generally to be the case with oxide, and not with Weldon Mud, we may with advantage look for some means of altering the physical state of the oxide before we reject it finally in favour of the rival material. We will return to this point later.

The thermic effects attendant on the fouling of the materials will indicate their relative avidities for sulphuretted hydrogen. In the case of oxide 34,386 calories were found to be liberated, and a temperature of 155° Fahr. reached, provided evaporation of water did not occur. In the case of Weldon Mud, 22,467 calories, and a temperature of 132° Fahr., only were found. Putting aside small differences, it is clear the thermal effects are nearly the same, if the larger percentage of active ingredient in the oxide be taken into account. The fouling of equal weights of active ingredients—ferric oxide and manganese dioxide—would be attended by the liberation of nearly the same amount of heat. The heat liberated would, indeed, if we looked into the matter closely, be found to be a trifle greater in the case of the ferric oxide. The avidity of the active ingredients for sulphuretted hydrogen being, however, naturally about equal, the greater proportion of the active ingredient in bog oxide indicates that this material should be more active than Weldon Mud as a purifying agent. The greater amount of water in the Weldon Mud as used, tends to keep down the temperature of the material, since the specific heat of water is very much greater than that of other components of either material. But the greater amount of gas which a given mass of oxide is capable of treating, compensates for the extra water in the Weldon Mud; and the temperature attained on complete fouling should be nearly the same for both materials. The calculations show a difference of only 23° Fahr.; and if a much greater or much less difference be generally observed, when revivification *in situ* is prevented, it argues incomplete fouling in the case of one material, and it again becomes pertinent to compare their physical states.

We may now pass on to compare the thermic effects of revivification of the completely fouled materials. The amount of heat liberated per 100 parts of the original material was shown to be about 25,664 calories in the case of oxide, and about 27,321 calories in that of Weldon Mud. If evaporation of the water did not occur, the temperature of the revivified mass would be about 603° Fahr. in the case of oxide, and about 640° Fahr. in that of Weldon Mud. It would therefore appear that the thermic effects are again about the same with the two materials; but if we consider the proportions of the active substances in each, we find that a difference is apparent. The heat liberated by the revivification of a given weight of a mixture of ferric and ferrous sulphides in the relative proportions in which they occur in fouled oxide, is little more than one-half that of the heat liberated by the revivification of the same weight of manganese sulphide. Hence we see that the energy with which revivification takes place is much greater with the manganese sulphide than with the iron sulphides, and that it is only owing to the much higher proportion of sulphide in the fouled ferric oxide that the manifestations of energy are about equal in the revivification of the two materials. Moreover, were the amount of water in the fouled material the same in both cases, the Weldon Mud would acquire a much higher temperature than the oxide during revivification. Throughout the phenomena of fouling and revivification, the *presence*, *formation*, and *evaporation* of *water* are the controlling factors. The amount of water present can be regulated within reasonable limits; the amount formed depends on the chemical reactions which take place, while the amount evaporated depends on the thermic effects of the chemical changes. The hygrometric state of the gas passing through the material also affects the quantity of water evaporated from it.

So far as the thermic effects of fouling are concerned, there appears no reason why the moisture in the material put into the purifiers should not amount to less than 18 per cent. of oxide or less than 40 per cent. of Weldon Mud, as in the absence of air the temperature attained in the purifiers cannot be very high. But the thermic effects of revivification indicate that it is necessary for safety that once-fouled material should contain not less than about 35 per cent. of its weight of free water if the material be oxide, or not less than about 42 per cent. if it be Weldon Mud. If in either instance the active ingredients were present in greater amount than we have assumed to be usually the case, the quantity of water in the fouled material should be even greater. That is to say, if the oxide contains more than 56 per cent. of ferric hydrate, the moisture in the fouled material should be more than 35 per cent.; and if the Weldon Mud contains more than 34 per cent. of manganese dioxide, the moisture in the fouled material should be more than 42 per cent. In cases where the material has ignited during revivification, the ratios between the amounts of active ingredient and water present cannot have been observed. On the other hand, the amount of water present in the fouled material should not greatly exceed the quantities shown, or the mass will scarcely rise in temperature, and the revivification will be very sluggish. After the first revivification, allowance must be made in subsequent foulings for the amount of free sulphur present. The specific heat of sulphur is about one-fifth that of water; and therefore for every 5 parts of sulphur present, the water may be reduced by 1 part, and the temperature attained will be virtually the same.

The inferences drawn from the thermo-chemical study of oxide and Weldon Mud may be succinctly stated thus: In fouling, the energy of the active ingredients appears to be nearly equal—the slight difference being in favour of oxide—but in revivification, Weldon Mud has an immense advantage. Hence Weldon Mud will revivify satisfactorily when mixed with a much larger proportion of inert material than can be present in the oxide. Therefore it follows that the life of Weldon Mud should be very much longer than that of oxide, since it need not be discarded until it contains a very much greater proportion of sulphur than the 50 per cent. or so which marks the practical limit of the life of oxide. Experience has already demonstrated in many cases the truth of this inference; but it does not appear that the reason of the prolonged efficiency of Weldon Mud has hitherto been pointed out.

We have finally to consider the point referred to in the beginning of this article—viz., to what extent ferric oxide and manganese dioxide are active in practical use. With regard to manganese dioxide, we have already indicated (*ante*, p. 644) that the reactions involved in fouling and revivification virtually extend under favourable conditions to every particle of it. Therefore the full theoretical efficiency of Weldon Mud as a purifying agent is achieved in practice. Such, unfortunately, is seldom the case with ferric oxide; and the reason undoubtedly lies in the fact that many particles of the oxide are in a condition in which they are physically inaccessible to the sulphuretted hydrogen. Oxide has been used for many years as a purifying material, and experience has shown that its value does not depend merely on its content of ferric oxide; and therefore it is strange that samples of utterly unsuitable material should still be submitted to gas managers. Yet this is continually happening. Material not 1 per cent. of which is attacked by sulphuretted hydrogen is at times offered to them! It therefore seems desirable, even at the risk of appearing to harp on a hackneyed topic, to point out the essential qualities of any oxide which is to be used as a purifying agent.

It should be permeable throughout its mass, and in a very fine state of sub-division, yet voluminous and spongy. It is useless, therefore, to grind calcined oxide very finely, for the gritty particles are quite untouched by sulphuretted hydrogen, and the gas could only be forced through the dense compact powder with the greatest difficulty. The natural Irish bog ore is the best oxide now commonly used; and its merit lies in the fact that it is of a very light porous structure, and a large proportion of the ferric hydrate or oxide in it is readily attacked by sulphuretted hydrogen. Yet there is no question that the theoretical efficiency of the material as a purifying agent is never attained in practice. The deficiency undoubtedly arises from some particles of the ferric oxide in the material being physically inaccessible to the sulphuretted hydrogen. It is, indeed, quite easy to artificially prepare ferric hydrate which is more completely fouled by gas than is the ferric hydrate of bog oxide. The use of such material for purification now seems out of the question, on account of the expense of its preparation. But ferric hydrate prepared by precipitation and drying in such a manner as would yield it in a light porous state resembling that of the air-dried Weldon Mud, would undoubtedly equal the latter material in affinity for sulphuretted hydrogen, and would revivify with sufficient energy to meet every reasonable demand made of it. Weldon Mud is an artificial product, and owes its great efficiency to its physical state far more than to any innate superiority of its active constituent. The fact that it is a bye-product of a great industry, and therefore obtainable for gas purification at a price at which it could not be profitably prepared for that purpose only, has given it an immense market advantage over other artificially-prepared products. No equally suitable bye-product containing iron instead of manganese is obtainable; and therefore bog oxide has hitherto been accepted without question as the most suitable ferric oxide or hydrate for gas purification. But it should not be forgotten that a superior

oxide can be artificially prepared at a considerably enhanced cost, and that such an oxide would, as a purifying agent, have an efficiency far more nearly approaching that of Weldon Mud. Under certain contingencies, the preparation of artificial ferric hydrate suitable for the purification of coal gas might become remunerative.

THE WELSBACH ELECTRIC LAMP.

We ventured in a "Note" in the "Journal" for Feb. 22 last (p. 397), to question the utility of the rare earths in the construction of mantles for electric lighting, notwithstanding the fact that the financial columns of many papers contained references to a Welsbach electrical mantle, which it was stated would greatly increase the efficiency of electric lighting. We based our scepticism on the fact that the best substantiated theory of incandescent gas lighting demanded the occurrence of combustion for the development of the peculiar power of the Welsbach mantle, in virtue of which it can readily be brought to a state of intense incandescence. In electric lighting the phenomena of combustion play no part; and therefore the Welsbach mixture, whether in the form of a "mantle"—a word with which some financiers would have us believe light may be conjured out of darkness—or in some form better adapted for the use of the electrician, seemed to be little fitted to work a revolution in lighting by electricity. The latest information to hand as to the nature of the Welsbach electric lamp bears out our prediction, for it appears that the rare earths have little to do with the latest invention of Dr. C. Auer von Welsbach. He, in common with other giant inventive geniuses, is not a man of a single idea; and having worked wonders in one direction with the rare earths, he did not hesitate to try other materials for another purpose. He recognized the limitations of the scope of his first grand discovery, and left it to an eager legion of plodding and capable scientists to work it out to its full consummation. There was work of a higher grade for him; and with the versatility of true genius, he sought his next triumph in a very different field, and with very different weapons to those of his earlier operations.

According to a leading article, which has the weight of Dr. H. Bunte's authority in his capacity of Editor, in the "Journal für Gasbeleuchtung," Dr. Welsbach has introduced the use of osmium in the incandescent electric lamp which he has lately invented. Osmium is a comparatively unknown metal, which is distinguished by possessing at once the highest specific gravity and the highest melting point of all known metals. It is associated with platinum and iridium in many platinum ores. Both in chemical and physical properties, it is as different a material from any of the rare earths of the Welsbach mantle as iron is from lime. The property of osmium of which Dr. Welsbach takes advantage, is its infusibility at any but the highest attainable temperatures. The intensity of the light emitted by an incandescent body increases more rapidly than the fifth power of its absolute temperature; and therefore a high temperature is clearly economical in the production of artificial light. A substance such as osmium, which does not change its state at abnormally high temperatures, therefore should prove a durable and efficient substitute for carbon in the filaments of incandescent electric lamps which are run at very high tension. In a vacuum, or in a reducing atmosphere, a filament of osmium may be heated to the temperature of the volatilization of platinum and iridium, and it shows no indication of volatilizing or melting; but at that temperature it emits a white light of blinding intensity. In a vacuum especially, such a filament may be heated by an electric current far above the melting point of platinum; and it remains solid. Only when the intensity of the current is enormous in comparison with the capacity of the filament, does the latter melt at one point. Pure osmium is, in a vacuum or a reducing atmosphere, the least capable of alteration or fusion of all substances known; and so at intensely high temperatures it must have the greatest power of emitting light.

Commercial preparations of osmium are unsuited for use without further purification. Pure osmium, or osmium containing a mere trace of platinum, gives tolerably elastic filaments suitable for use in electric glow lamps. Our German contemporary promises shortly to give details of Dr. Welsbach's method of manufacturing and preparing osmium filaments and attaching them in the lamps. It reports, however, some remarkable observations made by the inventor, which seem to indicate that more readily fusible materials than osmium may also be of hitherto unsuspected service in electric lighting. It is well known that a platinum wire, through which a sufficiently powerful electric current is passed, melts when it attains a white heat. If, however, the wire be closely enveloped by a thin yet dense and cohesive coating of highly refractory material, such as thorium oxide, the intensity of the current can be greatly increased before the wire will melt. Energy is withdrawn from the wire to its coating, and is radiated from the latter as light and heat. As the intensity of the current is increased, the radiation gradually becomes evident as a blinding light; and though the platinum is finally melted, the intensity of the current, and therewith of the light, can be raised still more, until the pressure of the vapour of the platinum ruptures the coating of refractory material. If a more difficultly fusible metal than platinum be used for the core, the intensity of the light may be still more increased. An extraordinarily magnificent and beautiful illuminating effect is secured if the coating of thoria be only a few tenths of a millimetre in thickness. The other rare earths, and lime, magnesia, and other so-called refractory materials, melt or vaporize too readily to be of much service for coating metallic filaments. Thorium oxide is used solely on account of its extremely refractory character, and does not serve, as in the Welsbach mantle, as a skeleton on which particles of cerium oxide may be insulated and allowed to exercise their peculiar catalytic powers. These powers, on which the special economy of incandescent gas lighting appears to depend, are not employed in the Welsbach electric lamp filaments; and their utilization in electric lighting continues out of the question.

The import of the results obtained by Dr. Welsbach with electric lamp filaments of osmium, and of that or some other difficultly fusible metal coated with thorium oxide, cannot be stated from a cursory glance at them. They foreshadow many possible developments in electric lighting which may bring it to an equality in point of economy with gas lighting. But on this point, the information to hand at present is insufficiently ample to enable us to pronounce an opinion. The materials of the new filaments are, however, extremely costly; and the manufacture of the lamps must of necessity be very difficult. We may perhaps find that Dr. Welsbach has presented the electrical world merely with a luxurious, but extremely expensive, method of illumination by electricity. Even now those persons who are reckless of the cost of renewals of electric lamps, habitually overrun their lights in order to obtain better illumination than the glow lamp used in the orthodox manner affords; and such people will no doubt welcome Dr. Welsbach's last invention. Whether lamps constructed with the new filaments can be used economically by the larger section of consumers of electrical energy depends, however, on a multitude of considerations, which cannot be profitably discussed until the present information is supplemented by many more particulars. In the meantime, we shall await the latter with the greatest interest.

Since the foregoing was written, we have seen a copy of the Austrian patent specification, which has just been published. The following are the "claims" made by Dr. Welsbach, as set forth in it:—

I.—Illuminating filaments for electric lamps, consisting of—
- (*a*) Osmium; or
- (*b*) osmium containing other platinum-metals, such as platinum, iridium, rhodium, ruthenium; or
- (*c*) a core of osmium, and a coating of thorium oxide; or
- (*d*) a core of an alloy of osmium and the platinum-metals specified in I. (*b*), or of these metals or their alloys, and a coating of thorium oxide.

II.—A process for the production of the illuminating filaments named in I. (*a*) and (*b*); the said process being characterized thus—
- (*a*) Osmium, or compounds therewith, are deposited in the metallic state on a thin metal wire or core by the reduction of a volatile osmium compound such as the tetroxide in a reducing atmosphere, and the metal core is subsequently volatilized by intense heating; or
- (*b*) osmium, or compounds therewith, are applied repeatedly in thin layers by the aid, for instance, of some cementitious medium to a thin metal wire or core, and the metal core is subsequently volatilized by intense heating; or
- (*c*) osmium, or compounds therewith, are deposited electrolytically on a metal wire or core, and the metal core is subsequently volatilized by intense heating; or
- (*d*) osmium, or compounds therewith, are applied in a state of pulp, by addition, for instance, of a cementitious medium repeatedly in thin layers to a thread of vegetable or animal origin, and the thread is converted by ignition to osmium; or
- (*e*) osmium, or compounds therewith, are formed into an emulsion with collodion, denitrated, and ignited.

III.—A process for the production of the illuminating filaments for electric lamps named in I. (*a*), (*b*), (*c*), and (*d*); the said process being characterized thus: Thin layers of thorium oxide are successively and repeatedly applied to the filaments described, which are ignited after each application; and this procedure is continued until a solid coating of thorium oxide has been formed on the filament.

The Gas Supply of Paris in the Past Year.—There was a decrease of £28,552 in the revenue from the sale of gas by the Paris Gas Company last year; the consumption having fallen off to the extent of about 95¾ millions as compared with the year 1896, which, however, was not only a leap year, but one in which Paris was very much *en fête*. The day consumption reached 103½ millions, or 31·68 per cent. of the total, against 30·49 per cent. in 1896. There were 24,272 additional consumers on the books at the close of the past year; making an increase of 90,350 in the three years 1895-7. Our usual abstract translation of the report of the Directors, which was presented at the recent annual meeting of the Company, will be given in due course.

ACCOUNTS OF THE METROPOLITAN GAS COMPANIES FOR THE YEAR 1897.

—	Chartered.	Commercial.	South Metropolitan.	All the Companies.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Capital and borrowed money	13,105,800 0 0	961,304 1 9	6,991,250 0 0 (a)	21,058,354 1 9
Income—viz.:				
Sale of gas by meter	2,801,527 9 9	277,234 14 0	934,503 19 0	4,013,266 2 9
Public lighting, including lighting under contracts	153,363 12 11	19,544 6 4	64,171 14 8‡	237,079 13 11
Rental of meters and stoves	27,642 13 5*	10,453 3 11	59,295 14 10	97,391 12 2
Residual products	621,801 2 5	69,207 12 1	277,819 4 2	968,827 18 8
Miscellaneous, including old materials	14,067 0 2	1,263 2 2	6,512 11 4	21,842 13 8
Total income from all sources	3,618,401 18 8	377,702 18 6	1,342,303 4 0	5,338,408 1 2
Expenditure—viz.:				
Coal and oil, including carriage and dues	1,195,172 6 1	145,080 16 9	479,088 1 8	1,819,341 4 6
Purifying materials, including labour	67,010 18 3	9,019 9 2	24,098 10 6	100,128 17 11
Salaries and wages—manufacture	394,790 10 5	45,995 16 9	115,854 13 1	556,641 0 3
Wear and tear—manufacture	309,650 1 5	33,775 12 7	155,869 17 3	499,295 11 3
Rents, rates, and taxes	232,516 18 5	14,368 9 7	58,694 9 2	305,579 17 2
Salaries—management	18,615 16 9	2,243 15 8	4,544 8 1	25,404 0 6
Collectors' salaries and commission	37,741 6 9	3,341 11 5	15,718 17 3	56,801 15 5
Stationery, printing, and general charges	18,602 1 6	2,130 4 9	10,320 18 10	31,053 5 1
Directors and auditors	5,900 0 0	2,650 0 0	3,725 0 0	12,275 0 0
Salaries and wages, wear and tear—distribution	186,440 3 0	13,750 17 6	74,997 1 7§	275,188 2 1
Repair and renewal of meters and stoves	101,385 8 0	8,436 18 0	27,057 2 5	139,879 8 5
Law and parliamentary charges	6,078 13 0	201 13 9	6,234 18 1	12,515 4 10
Bad debts and extraordinary expenses	41,855 2 9†	1,569 9 8	29,779 13 9‖	73,204 6 2
Total expenditure on revenue account	2,618,759 6 4	282,564 15 7	1,005,983 11 8	3,907,307 13 7
Gross profit	999,642 12 4	95,138 2 11	336,319 12 4	1,431,100 7 7
Do. per cent. on capital and borrowed money	7 12 6	9 18 0	4 16 2	6 15 11
Do. do. gas-rental	33 16 7	32 1 2	33 13 6	33 13 5

(a) Converted. * Stoves only. † Including annuities, £25,698. ‡ Including £7262 for the six months ending Dec. 31, 1897, for lighting and repairing public lamps.
§ Including £4436 labour for gas-fittings. ‖ Including £7703 paid to pension, &c., funds, and £18,562 paid under profit-sharing scheme.

TABLE *showing the Capital, Income, Expenditure, and Profit, per Ton of Coal Carbonized (including Oil), in* 1897.

—	Chartered.	Commercial.	South Metropolitan.	All the Companies.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Capital and borrowed money	6 2 3·49	8 17 6·65	7 11 0·71	6 6 11·70
Income—viz.:				
Total gas-rental	1 7 6·86	1 3 11·31	1 1 6·94	1 5 7·54
Rental of meters and stoves	3·09	10·12	1 3·37	7·05
Residual products	5 9·63	5 7·00	6 0·03	5 10·10
Miscellaneous, including old materials	1·18	1·22	1·70	1·58
Total income from all sources	1 13 9·16	1 10 5·65	1 9 0·04	1 12 2·27
Expenditure—viz.:				
Coal and oil, including carriage and dues	11 1·82	11 8·45	10 4·22	10 11·64
Purifying materials, including labour	7·50	8·73	6·25	7·24
Salaries and wages—manufacture	3 8·21	3 8·53	2 6·04	3 4·28
Wear and tear—manufacture	2 10·67	2 8·70	3 4·11	3 0·13
Rents, rates, and taxes	2 2·04	1 1·91	1 3·22	1 10·11
Salaries—management	2·03	2·17	1·18	1·83
Collectors' salaries and commission	4·23	3·23	4·09	4·11
Stationery, printing, and general charges	2·08	2·06	2·68	2·25
Directors and auditors	0·66	2·57	0·96	0·89
Salaries and wages, wear and tear—distribution	1 8·83	1 1·31	1 7·44	1 7·91
Repair and renewal of meters and stoves	11·69	8·17	7·02	10·12
Law and parliamentary charges	0·69	0·20	1·61	0·91
Bad debts and extraordinary expenses	4·68	1·52	7·72	5·30
Total expenditure on revenue account	1 4 5·23	1 2 9·55	1 1 8·83	1 3 6·72
Gross profit	9 3·93	7 8·10	7 3·21	8 7·55

TABLE *showing Increase or Decrease in each Item during* 1897 *compared with* 1896.

—	Chartered.		Commercial.		South Metropolitan.		All the Companies.	
	Inc.	Dec.	Inc.	Dec.	Inc.	Dec.	Inc.	Dec.
	£	£	£	£	£	£	£	£
Capital and borrowed money	180,850	..	52,859	..	394,621	..	628,330	..
Income—viz.:								
Sale of gas by meter	124,788	..	21,617	..	73,443	..	219,844	..
Public lighting, including lighting under contracts	1,258	..	319	..	1,415	..	2,991	..
Rental of meters and stoves	3,593	..	2,084	..	7,789	..	13,466	..
Residual products	..	57,589	..	4,608	..	10,983	..	73,180
Miscellaneous, including old materials	1,104	..	67	..	417	..	1,588	..
Total income from all sources	73,149	..	19,479	..	72,081	..	164,709	..
Expenditure—viz.:								
Coal and oil, including carriage and dues	42,504	..	11,113	..	40,789	..	94,403	..
Purifying materials, including labour	..	1,125	717	..	1,650	..	1,142	..
Salaries and wages—manufacture	10,508	..	1,733	..	1,356	..	13,597	..
Wear and tear—manufacture	3,021	..	124	..	23,085	..	26,230	..
Rents, rates, and taxes	2,861	..	..	285	..	931	1,645	..
Salaries—management	908	..	7	..	..	210	705	..
Collectors' salaries and commission	2,092	..	245	..	786	..	3,123	..
Stationery, printing, and general charges	188	..	..	51	252	..	389	..
Directors and auditors	..	..	..	..	..	..	..	..
Salaries and wages, wear and tear—distribution	..	613	897	..	..	1,753	..	1,469
Repair and renewal of meters and stoves	9,277	..	845	..	..	2,502	7,620	..
Law and parliamentary charges	1,609	..	54	..	2,549	..	4,212	..
Bad debts and extraordinary expenses	337	..	..	361	2,885	..	2,861	..
Total expenditure on revenue account	71,467	..	15,038	..	67,956	..	154,461	..
Gross profit	1,682	..	4,441	..	4,125	..	10,248	..
Do. per cent. on capital and borrowed money	..	£0 1s. 11d.	..	£0 1s. 8d.	..	£0 4s. 7d.	..	£0 3s. 2d.
Do. do. gas-rental	..	1 8 11	..	0 18 10	..	2 5 8	..	1 12 1

OBITUARY.

Many of our readers will regret to learn that Mr. JOHN COLE, who for more than thirty years was foreman at the Horseferry Road station of The Gaslight and Coke Company, died on the 10th inst., at his residence in Westminster, in his 66th year.

The death is announced of Mr. MERVYN PADGETT CROFTON, the late Supervisor of the Dublin Corporation Water-Works. After forty years' service in the capacity mentioned, Mr. Crofton retired two years ago through ill-health. His death (which occurred last Thursday) had been expected for some time.

In the "JOURNAL" for the 8th ult. we noticed the retirement of Mr. HENRY TEAGUE from the position of Water Engineer to the Lincoln Corporation, after more than half-a-century's connection with the water undertaking. Mr. Teague did not relinquish his duties till the 25th ult.; and we regret to record that he did not long enjoy the rest he sought when he placed his resignation in the hands of the Water Committee. He had been in failing health for some months, and died at his residence in Lincoln on Monday last week, in his 78th year.

PERSONAL.

Mr. JONATHAN DODGSON has, through infirmity, resigned the Chairmanship of the Elland-cum-Greetland Gas Company, Limited, and is succeeded by Mr. JOHN WILSON, J.P.

Mr. FREDERICK THORPE, Assistant Gas and Water Engineer to the Widnes Corporation, has been selected out of 62 candidates to fill the post of Engineer and Manager of the Colne Corporation Gas-Works, in succession to Mr. H. Simmonds (who has gone to Bury), at a salary commencing at £225 per annum. Mr. Thorpe has received his entire training under Mr. Isaac Carr, Assoc.M.Inst.C.E., the Gas and Water Engineer to the Widnes Corporation.

Mr. ANDREW WILSON, Engineer to the Perth Gas Corporation, was married in St. Bernard's Parish Church, Edinburgh, last Thursday, to Constance Mary, the fourth daughter of the late Mr. John Greig, of Leith. In the course of the previous week, the officials and other employees of the Coatbridge Gas Company met Mr. Wilson at the gas-works, and presented to him a handsome and valuable set of cutlery and silver plate. Before he became an assistant at the Carlisle Gas-Works, Mr. Wilson was for some time in the practical department at the Coatbridge works, where his father (Mr. T. Wilson) is the Engineer and Manager. While thus engaged, he earned for himself, to the greatest possible degree, the respect and good-will of his fellow-employees in all grades. Since then they have watched his career with the utmost interest; and on his appointment to the managership at Perth—one of the most important positions in the Scottish gas industry—they were among the first to offer their hearty congratulations. They therefore felt that they could not allow the present occasion to pass without participating in the numerous expressions of esteem and in the many good wishes which are being extended on all hands to Mr. Wilson. Mr. W. Johnston, the cashier of the Company, made the presentation; and, in acknowledging it, Mr. Wilson returned his sincere thanks. Subsequently the company were entertained to light refreshment by Mr. T. Wilson.

Mr. JOHN C. BELTON has resigned his position as Engineer and Manager of the Redhill Gas-Works; and, we understand, the Directors do not propose to appoint anyone in his place. The circumstances attending Mr. Belton's resignation are peculiar, and should enlist for him the sympathy of the profession. For a great many years the Chairman of the Redhill Company had taken an active oversight of the undertaking; but when amalgamation with the Reigate Company was contemplated, it was found necessary—in view of the alterations and extensions which must follow—to reorganize the Redhill staff, and supplement it by the appointment of an Engineer. Mr. Belton received the congratulations of his professional friends when it was announced that he was the successful candidate for the appointment; he previous to that having satisfactorily filled the post of Gas Engineer and Manager at Wellington (Salop) for seven years, and at Willenhall (Staffs.) for three-and-a-half years. When he resigned the latter appointment to take up his new duties at Redhill, nothing was hinted as to the permanency of the appointment depending upon the success of the amalgamation scheme. But, in consequence of the opposition of the Reigate Corporation to the Bill promoted by the Company, that scheme proved abortive; and the Corporation having, as mentioned in the "JOURNAL" last week, given notice of their intention to promote a Bill next session for power to acquire the works of both Companies, the Directors were not prepared to go on with the extensions previously contemplated. Thus the circumstances which had necessitated the appointment of an Engineer ceased to exist; and, acting upon a suggestion made as to the necessity for retrenchment, Mr. Belton tendered his resignation—giving three months' notice in accordance with the terms of his agreement. The Directors in accepting Mr. Belton's resignation marked their sense of his unfortunate position, and their desire to assist him in obtaining another appointment, by handing him a cheque covering the three months' notice, so as to enable him to take advantage of any vacancy that might offer—at the same time expressing their good wishes for his success.

NOTES.

The Causes of Boiler Corrosion.

Mr. Maxwell Williams, writing on the basis of his experience as a marine superintendent and also as agent for boiler insurance, has recently communicated to "Engineering" his views respecting corrosion and scale in steam-boilers. Admitting that air and gases combined with water act corrosively on iron and steel, he declares his inability to see how, after it enters the boiler, sufficient air or gas can remain in the feed water to have any serious effect, since much would be immediately expelled and rise into the steam space. If the air in water is the cause of corrosion, why should not all boilers be pitted? Mr. Williams is of opinion that electrolytic action has more to do with the pitting of boiler plates than air or gases in the feed water. If the wasting of boiler plates is due to electrolytic action, this would proceed from acidity of the water, coupled with a variation of the composition of the plates. The destructive effect of the acid is probably increased by the high temperature; and it may be that the plate itself becomes a better positive element by intense heat, and therefore more liable to corrosion. Mr. Williams's experience is that rolled zinc, which is a very good positive element, and common soda, which is a cheap and efficient acid neutralizer, are fairly effectual in checking corrosion. If such action is due to air in gases, this remedy lacks explanation.

A Test of Arndt's "Econometer."

A report on Arndt's "Econometer"—an instrument for continuously indicating, on the principle of the gas-balance, the proportion of carbonic acid in furnace gases, and consequently gauging the efficiency of the combustion—has been made to the Franklin Institute. After describing the apparatus, the report states that a practical test of its merits was made on a boiler furnace at the Baldwin Locomotive Works. Check analyses of the furnace gases were made by Professor Keller; and thus the Committee were satisfied as to the substantial accuracy of the instrument. For all practical purposes, therefore, the Committee regard the "Econometer" as offering indications of the composition of furnace gases quite as reliable as ordinary analyses. They go further, and record their opinion that the use of such an appliance is calculated to be beneficial to the owners of steam-boilers and industrial furnaces, as exhibiting at all times the more or less favourable conditions of combustion. At the Baldwin Works, a Babcock and Wilcox boiler, burning anthracite, showed carbonic acid ranging from 3·6 to 11 per cent. in the waste gases; corresponding to a loss of fuel, due to excess of air, of from 45 to 16 per cent. The latter is a very fair result, and was arrived at by using the forced blast of a steam-jet blower. Directly the blower was put on, the duty rose; and when it was taken off, the results in carbonic acid fell again.

An Endothermic Mineral.

Search after natural sources of helium and argon is leading Professor Ramsay and his associates into strange byways of mineralogy, where unexpected phenomena are met with. Such an experience has been recounted to the Royal Society in a communication by Dr. Ramsay and Mr. M. W. Travers upon "fergusonite," an endothermic mineral. In these days of incandescent gas lighting, none of the properties of the "rare earths" are to be neglected. The mineral referred to occurs in felspar and mica deposits, in the same manner as most of the rare Norwegian minerals. It is a black, lustrous substance, not unlike obsidian in outward appearance; but of considerably higher density. It is not crystalline, but homogeneous; and it shows no sign of cavities. Like similar minerals, it contains helium, which is expelled on the application of heat. But this mineral presents a peculiarity. When heated to a temperature not exceeding 500° or 600° C., it suddenly becomes incandescent, and gives off much of its helium, while its density decreases. Analysis shows that "fergusonite" is mainly a niobate of yttrium, containing oxides of uranium, but in no great quantity. The amount of heat lost by it in parting with its helium was determined by experiment. Various questions are raised by the behaviour of this remarkable mineral. There is only one other known substance which decreases in density, while it evolves heat, and that is water in changing to ice. The authors suggest that these rare minerals are relics of that period of the history of the earth before solidification had set in.

Fracture as a Test of Iron.

Some instructive observations on the appearance of fractures of iron and its connection with the quality of the metal occur in a paper by Mr. E. A. Uehling on sandless pig iron, read before the Pittsburgh Foundrymen's Association. The enormous development of American blast-furnaces of late years has necessitated the reform of the old systems of running the metal into pigs and subsequently handling it. Consequently, the casting-machine has been introduced, which turns out clean pig without the sand. Among the benefits of the change is cited the abolition of "grading by fracture" in foundry practice. Mr. Uehling declares that the fracture of pig iron is a delusion and a snare. He states that the value of an iron does not depend upon its fracture; nor is the fracture any guide as to the special purpose for which a certain iron may be best suited. It is an indication of the condition of the furnace that produced it, and not even an altogether reliable indication of this. The principal factor that

determines the grain in the fracture of cast iron is the time given it to pass from the liquid to the solid state. Of two castings poured from the same ladle, the lighter is invariably the closer grained. The degree of hardness resulting in a casting is not determined by the fracture of the pig, but entirely by its chemical composition and the rate of cooling. The chemistry of the foundry is yet in its infancy. It is claimed for the new sandless pig iron that it melts quicker and with a smaller quantity of fuel than sand pig, is less liable to contamination by impurities in the fuel, and makes a cleaner casting.

COMMUNICATED ARTICLES.

THE WORK OF THE SCRUBBERS AND PURIFIERS.

By Stephen Carpenter, of East Ham.

In a previous article,* the gas produced in the retorts was followed through the condenser to the inlet of the exhauster. When the gas leaves the last-named appliance, while still containing ammonia, it passes on to the scrubbers, where this impurity is washed out or absorbed by water; ammonia being extremely soluble. This absorption is effected in the following way: A series of iron vessels, called scrubbers, are provided. (The writer prefers the kind known as "tower" scrubbers.) The gas passes in at the bottom of the vessel, and in ascending is met by water falling from the top. The gas is broken up, as it were, in its upward passage, by a number of intervening wood grids lying across each other almost to the top of the scrubber; or the vessel may be fitted with strong iron grids at about 3 feet from the bottom, so that broken bricks or the like may rest upon them, and fill the scrubber to the top, but leave a space of 3 feet to allow the gas to pass away. This arrangement will enable the gas to be presented in a finely-divided state to the down-pouring water; and by this means the ammonia will be washed out—or, in other words, absorbed—by the liquid, and the gas will pass onward to the purifiers.

When scrubbers were first erected, nearly forty years ago, they were intended to purify the gas in closed vessels; but they did not do it. What they will do, however, is this—they will take out the ammonia, a large portion of the sulphuretted hydrogen, and some of the carbonic acid; and this is a great help where lime is used for the removal of the last-named impurity and bisulphide of carbon.

The height and diameter of the scrubber will vary according to the make of gas. The writer worked four tower scrubbers for many years. They were about 26 feet high and 8 feet diameter. There was a tank at the bottom; and a pump was provided for each scrubber, to raise the water and ammoniacal liquor to the top. They were pumped through a 2-inch pipe, to which were connected three ¾-inch tubes, which were passed through at the top of the scrubber. On the end of each was fitted a ¾-inch cap, in which was a ¼-inch hole, so that the water pumped from the tank might play on to a disc fitted about 4 inches below the cap. This caused the water and liquor to spread like rain on to a layer of birch lying on the top of the bricks or the grids. The birch should be 1 foot below the outlet-main of the scrubber. The bottom of each scrubber was fitted with a self-acting syphon, to convey the liquor into the tank.

The action of the scrubbers is as follows: Gas from the exhauster passes in at the bottom of No. 1 scrubber, and then through Nos. 2, 3, and 4. The tank at the bottom of No. 4 is supplied with fresh water, in the proportion of 10 to 12 gallons per ton of coal carbonized. This water is pumped to the top of the scrubber, and it passed through the ¾-inch pipes on to the brick, which causes the water to subdivide and fall down the interior of the vessel in the form of rain. As previously explained, the gas in ascending meets the water, which absorbs the ammonia. The water is drawn off at the bottom by a self-acting syphon, and conveyed to the tank at the bottom of No. 3 scrubber. This weak liquor is pumped up to the top of No. 3, which is fitted up in the same manner as No. 4. The liquor from the bottom of No. 3 is conveyed to the tank at the bottom of No. 2. The liquor from the hydraulic main goes into the tank at the bottom of No. 3, where it mixes with the liquor from that scrubber, which is pumped to the top of No. 2; and from the tank at the bottom of No. 2, the liquor is pumped to the top of No. 1.

In a set of four scrubbers, the pumps for Nos. 1 and 2 should be rather larger than those for Nos. 3 and 4, as the former have to raise the fresh water and the ammoniacal liquor from the hydraulic main. The liquor from No. 1 scrubber is conveyed into a large service-tank. It will be of sufficient strength for commercial purposes; but if, by accident to any of the pumps, it is not up to the proper standard, by having a connection between the service tank and the one at the bottom of No. 2 scrubber, it can be run back, and passed through Nos. 2 and 1, so as to bring it up to the right strength. At the bottom of each scrubber there should be a 2-inch cock, for drawing off any thick tar or other sediment that may accumulate.

The manner in which these scrubbers are worked should be specially noted. The gas enters at No. 1, and goes through the four scrubbers; and the water passes into No. 4, and meets the gas in its passage. It is well known that water will absorb a large portion of the carbonic acid and part of the sulphuretted hydrogen; and this will assist the lime in purifying the gas from carbonic acid and bisulphide of carbon, and will prevent the tar from passing on to the lime purifiers. Tower scrubbers are not very expensive to keep in order. Steaming them about once a year will keep them in good condition. If not convenient to have four, two should be put up. Two small ones are better than one large one. The writer has worked tower scrubbers for nearly forty years, and has had good results from them.

A few observations may now be made on the size of lime and oxide of iron purifiers relatively to the make of gas. Where lime is used to take out the carbonic acid and the bisulphide of carbon, it is not so much depth as surface of material that is required for the removal of these impurities. It is more advantageous to have a good surface of lime in thin layers, than a smaller surface and thick ones. What the writer means by "thick" layers of lime, is when they are from 7 to 8 inches thick, or even more. By "thin" layers, he means from 4½ to 5 inches thick. The reason he prefers thin layers is that when the gas is first turned into a purifier it enters with considerable velocity; and if the lime is very thick, it offers great resistance to the gas. If there should happen to be a weak place in the layer, the gas would pass through that part much quicker than the other. But if the layers are thin, they will offer less resistance. It is much better to have four layers of lime 5 inches thick than two of 8 or 9 inches; for with four layers there are four surfaces of lime, whereas with two there are but two.

When the crude gas is turned into the first lime purifier, the lime has a greater affinity for carbonic acid than for sulphuretted hydrogen. The lime is so active in taking out the former impurity, that part of the latter passes on to the next layer, and converts the material into hydrogenated sulphide of calcium. Then the reduction of the bisulphide of carbon is commenced. After the gas has passed the four surfaces of lime, it leaves behind it all the carbonic acid, part of the sulphuretted hydrogen, and part of the bisulphide of carbon. The remaining sulphuretted hydrogen passes on to the second purifier, where the lime is ready to remove another portion of the bisulphide of carbon. The writer's advice is: Never have thick layers of lime, if it can possibly be prevented, as the impurities get so intermixed in them. It is much the best plan to have thin ones. When the crude gas first comes in contact with the lime, if there are four layers in the purifier the impurities will be deposited in the first and second layers. The carbonic acid will be taken out mostly in the first layer, and the other three layers will be free to absorb a portion of the bisulphide of carbon.

There should be a test for sulphur at the inlet and outlet of the first purifier; and if this shows more of the impurity at the latter than at the former, the purifier should be thrown out of action. If the crude gas is allowed to keep passing through the foul lime in the first purifier, a newly-formed impurity, called sulpho-carbonic acid, will make its appearance; and the quantity of sulphur in the gas will be very great. It will not only show high results at the outlet of the purifier, but will interfere with the lime in the second purifier. What the writer is about to say on the subject of the formation of sulpho-carbonic acid in the purification of coal gas may be called supposition; but, supposition or not, this acid will make its appearance if the lime is worked too long before changing the purifier. Sulpho-carbonic acid is a bye-product. It is generated by allowing the crude gas to keep passing through the foul lime after the material has become saturated with other impurities, and especially with carbonic acid. It is well known that carbon disulphide (CS_2) corresponds to carbon dioxide (CO_2). The latter combines with basic sulphide, forming a salt—sulpho-carbonic acid—corresponding to the carbonates, but containing sulphur in place of oxygen, calcium carbonate ($CaCO_3$), and calcium sulpho-carbonate ($CaCS_3$). The salts of this acid are formed similarly to the carbonate, on adding carbon disulphide to an alkaline sulphide. Lime is of an alkaline nature; and when it becomes hydrogenated sulphide of calcium, it is just the thing to form this sulpho-carbonic acid. This would mix with the gas, and give very high results in bisulphide of carbon.

The writer has often noticed, when testing for sulphur, when the results of the test have been high, that, instead of finding a white powdery ash in the crucible, there would be small flakes of sulphate of barium; showing that sulphur in other forms than sulphuretted hydrogen was present in the gas in large quantities. Many years ago, oxide of iron was substituted for lime for the purification of coal gas; but as oxide only takes out the sulphuretted hydrogen, lime was introduced again to remove the carbonic acid and part of the bisulphide of carbon. In the early days, when lime was used again to take out a portion of the bisulphide, certain mysterious troubles arose which checked the progress of the removal of the sulphur compounds other than sulphuretted hydrogen. Sometimes the sulphur was down to from 12 to 14 grains in 100 cubic feet of gas, while at others it was for several days much higher than the sulphur in the crude gas. After testing the gas at the inlet and outlet of the lime purifier, and finding the results higher at the outlet, the writer came to the conclusion there was something wrong with the chemical action of the lime. As he was determined not to be beaten over this matter, he made a searching investigation,

* See "Journal," Vol. LXX., p. 1231.

as careful consideration is assuredly the only way by which correct knowledge of a subject can be acquired. Acting on this principle, he carried on a series of experiments until he found whence these discrepancies arose; or, at any rate, he discovered some of the minor causes of them. These he will deal with in another article.

THE WORKING VALUE OF FUELS.

By THOMAS FLETCHER, F.C.S.

In some experiments carried on at the New York State Veterinary College, it was found that the heat lost by ventilation was 39 per cent. of the whole; and my attention has been called to the fact that these figures, which may be taken as correct, differ seriously from those given in my book on the "Commercial Uses of Coal Gas," where the amount lost in Messrs. Walker's bottling-stores is given as varying from 22½ to 25 per cent. The explanation is simple. The minimum ventilation required in living-rooms is 500 cubic feet of air per hour for each adult; while in bottling-stores only a fraction of this is needed—in fact, no provision whatever is made for ventilation, and all which takes place occurs from leakages, and the constant opening of doors for the passage of trucks and barrels. The figures given by me are clearly stated as being observed results in practice, in bottling-stores only. I had no opportunity, before the book was published, of making any exact experiments in living-rooms; these being very difficult, if not impossible, under ordinary conditions in any house, the speed of the air currents in the flues varying almost from minute to minute. Recent experiments in rooms where the ventilation is controlled and can be measured, have established a rule, which may be safely relied on for every practical purpose. The accepted standard is the British thermal unit—*i.e.*, the amount of heat necessary to raise the temperature of 1 lb. of water 1° Fahr.—and 1 unit is required per hour for each degree rise in the temperature over the outside, for each square foot of glass, or for every 4 square feet of exposed wall, and two-thirds more for the loss of heat by ventilation in ordinary living-rooms.

The loss of heat in living-rooms remains an unknown quantity, as it varies in every room, and in the same room from hour to hour. But taking the theoretical value of coal gas at 660 British thermal units per cubic foot consumed, that of coal at 13,000 units per pound, and that of coke at 10,000 units per pound, it becomes easy to calculate the effective value and the loss of heat in different systems. A flueless gas-stove may be taken as the highest type of efficiency; and using this, 1 cubic foot of gas per hour will be required for every 660 square feet of glass, or every 2680 square feet of exposed wall, for every 1° rise of temperature over the outside, and in addition to this ⅔ cubic foot for loss by ventilation. Taking a room 22 feet square and 10 feet high, with all walls exposed, 2 cubic feet of gas per hour will maintain a rise of 3° over the outside, allowing for the average window surface. The exact figures for warm-air stoves with flues, and for open fires, are not available, and perhaps not possible; but for average practice, it may be taken that nearly one-half the total heat is lost in a warm-air stove with a flue, and two-thirds with an open fire. This can hardly be considered as all loss, as the ventilation necessary for comfort and health cannot be always obtained without some assistance, and the so-called loss may be partly taken as useful work done. The whole subject is beset with variations and difficulties, and any standard can be proved to be seriously wrong in individual cases. But the figures given may be taken for average work. It must be clearly understood that the figures are for maintaining the heat, not for raising the temperature of any room quickly, for which a much larger fuel consumption is required.

These figures work out in practice in greenhouse heating, where steady temperatures are required night and day; and the loss from any system of boilers or stoves can be readily calculated—a matter of interest to nurserymen, whose fuel consumption is a question of vital importance. The loss in most forms of boilers is enormous; and the subject needs careful consideration. For this purpose, the calculation is exceedingly simple, on the basis of 10,000 units per pound of coke. One pound of coke burnt per hour will give a rise of 10° for every 1000 square feet of glass, or 4000 square feet of exposed wall, not allowing for loss by ventilation. For this, one-half more fuel must be allowed. This gives us the maximum possible duty; and a comparison with the fuel burnt gives the waste. Where the flue-heat is not utilized, there is no doubt that at least 50 to 60 per cent. of the fuel is completely wasted in most of the systems at present in use; and the value of the fuel is not considered as it should be. In my own case, with a Chatsworth boiler, burning gas coke, and heating a range of houses 45 feet by 30 feet, one-half of which is kept at a tropical temperature, the flue-heat not being used, the calculated consumption is 8 lbs. per hour by theory, allowing one-eighth loss for wind, as the houses are on high ground, and rather exposed. (This wind allowance will vary in different districts.) The actual winter average is 11¾ lbs. per hour, showing a waste of 31½ per cent.—nearly one-third of the fuel—this being with a first-class boiler, clean, well set, carefully fired, and of the correct size for its work. It is very doubtful if better results could be obtained in practice under any ordinary conditions.

The following rule may be taken as a guide for coke-fired greenhouse boilers: For every 1000 square feet of glass, and for every 4000 square feet of exposed wall, for each 10° rise of temperature over the outside—

Loss through glass and walls	. . . . .	16 oz. per hour.
„ by ventilation	. . . . .	8 „
„ „ wind (average)	. . . . .	3 „
„ „ boiler and flue	. . . . .	13 „
Total	. . .	40 oz. (2½ lbs.)

Three-fourths of the flue loss can be recovered by taking these under the beds in the houses. Any fuel consumption over this may be taken as waste which can be prevented.

Iron and Steel Institute.—At the spring meeting of the Institute, which will be held at the Institution of Civil Engineers on the 5th and 6th prox., under the presidency of Mr. E. P. Martin, of Dowlais, Mr. J. H. Darby, of Brymbo, will deal with the subject of coking in bye-products ovens.

The Workmen's Compensation Act, 1897.—At the meeting of the St. Pancras Vestry last Wednesday, it was announced that a letter had been received from the Home Secretary, in reply to a communication from the Vestry, stating that "he is advised that electric lighting works, where electricity is generated by the use of mechanical power, and is supplied to consumers, are factories within the Factory and Workshops Acts, and therefore the Workmen's Compensation Act will apply in all such cases." According to this advice, there can be no doubt that works where gas is produced by the use of mechanical power are factories, and also come under the Act. The Crown Solicitor of New South Wales has also expressed the opinion that a "place engaged in the generation of electricity" is a factory within the meaning of the Factory Acts.

The Metropolitan Water Supply Commission.—The Commission yesterday held their first sitting, after the Easter adjournment, at the Westminster Town Hall—Viscount Llandaff presiding, and all the Commissioners except Sir John Dorington and the Right Hon. J. W. Mellor being present. Mr. G. Prior Goldney, whose examination had not concluded when the last adjournment took place (*ante*, p. 785), was now recalled, and gave further evidence regarding the position and views of the City on the water question. The City, he said, were keeping an open mind as to whether there should be purchase or public control. The position was that, subject to the City being sufficiently represented by the purchasing and managing body, and to the price not being exorbitant, they would prefer purchase; but if the price was not what they considered right, or the representation was inadequate, they would prefer control. The City did not want any particular sort of arbitration—certainly they could not hope for the special terms the County Council had suggested. They would be in favour of purchase at a price which would not impose upon them any extra charge.

Prize for an Unbreakable Incandescent Mantle.—The Society Nazionale per l'Incandescenza a Gas, of Firenze, have instituted a competition for an unbreakable incandescent mantle. It will be open to persons of all nationalities till Dec. 31 next. The prize (50,000 lire, or about £2000) will be awarded after a month's trial in the open air. The mantle must not break on falling to the ground from a height of 1 metre; but it may be put out of shape. It must not be fusible at the temperature of an explosive mixture composed of 2 volumes of hydrogen and one volume of oxygen. It will be required to have an illuminating power of 250 Hefner candles (about 206 English candles) when supplied with gas at a pressure of 1 inch, and to be applicable with gas at lower pressure; and its luminosity must not diminish in a marked degree after 2000 hours' burning. Its maximum consumption is to be 150 litres (5·3 cubic feet) of gas per hour; and its price is not to exceed 2 lire. The shape and construction of the mantle may be the same as in the Auer mantle. If the mantle furnishes the above-named amount of light without requiring a glass chimney, the prize will be raised to 60,000 lire; and to 100,000 lire if it can be lighted automatically by simple contact with the gas.

The Southampton Gas Company's Rating Appeal.—In the "JOURNAL" last week, it was briefly notified that the Recorder of Southampton (Mr. E. U. Bullen), the Arbitrator in the above-mentioned appeal, had made his award. The Guardians had increased the rateable value of the Gas Company's property from £11,010 gross and £6790 net, to £12,724 gross and £9118 net. The Arbitrator has found the gross value to be £9362, and the rateable value £7282; the former being a reduction of £3362 in the amount appealed against, and of £1648 in the original figure, while the latter, as mentioned last week, is a reduction of £1836 in the rateable value. The cardinal point at issue was the tenant's allowance on working capital. The Company's witnesses claimed 17½ per cent. on the whole; whereas figures put in for the Guardians varied from 17½ down to 7½ per cent.—the average being 12½ per cent. As far as we remember, however, such an allowance has never been adopted in the case of a Gas Company by any Court of Quarter Sessions, though an attempt was made a few years ago to get less than 17½ per cent. In the present case, the Arbitrator appears to have adhered to the established rule. The Guardians have had to learn a hard, but it may be hoped a useful, lesson at the hands of their own Recorder.

TECHNICAL RECORD.

WAVERLEY ASSOCIATION OF GAS MANAGERS.

Half-Yearly Meeting in Edinburgh—Standardizing Meter Unions.

The Seventy-fourth Half-Yearly Meeting of the above-named Association was held in Milton Street Hall, Edinburgh, on Thursday last. This was the first occasion on which the Association had met in Edinburgh; and it being somewhat of an experiment, there was some anxiety as to the result. This was, however, altogether satisfactory to those who advocated the change from the practice of holding the spring meetings at localities where members are situated, to Edinburgh, which is better for access than are some of the towns in the district. There was a large attendance of members, from all parts of the district. In addition to these, there were also present, in an official capacity, Mr. T. Wilson, of Coatbridge, the President of the North British Association of Gas Managers; Mr. A. Bell, sen., of Dalkeith, the Past-President; Mr. A. Yuill, of Alloa, a member of the Committee; and Mr. R. S. Carlow, of Arbroath, the Secretary and Treasurer—all of whom attended with the view of enlisting the support of the Waverley Association to the scheme of the North British Association for the standardizing of meter unions. Mr. W. R. Herring, the Engineer to the Edinburgh and Leith Gas Commission, was present during the latter part of the meeting; and there were also in attendance Mr. James Milne, Mr. Henry O'Connor, Mr. A. MacPherson, Mr. D. Macfie, Mr. Lumsden, and Mr. W. D. Helps, of Leeds, as representatives of Messrs. James Milne and Son, Limited, of Edinburgh, London, Glasgow, and Leeds, whose guests the Association were at the termination of the meeting.

Mr. H. Rutherford (Aberlady), the President, took the chair. In his introductory remarks, he said he had no practical address prepared; believing, as he did, that this being the first time the Association had held their meeting in Edinburgh, it would be more a day for sight-seeing than for speech-making. Having nothing to bring before them which was new, he also thought it would be presumptuous in one who held a very small position in the gas profession to come there to address gentlemen who, he knew, had had far more experience than himself in matters pertaining to gas and its manufacture. But as an old member of the Association, he might mention that the old members never had any pretensions in the way of reading papers; and if his memory carried him right, the Chairman was only appointed on the morning of the meeting. They had, however, the same objects in view then as now—meeting together for the purpose of exchanging ideas on all matters connected with the gas industry. As an old member, he was very pleased that they were progressing; and he had no doubt they would continue to do so, as he might say that the Association consisted nearly altogether of new members since he joined it—with perhaps the exception of Mr. Taylor, of Jedburgh, their much-respected and esteemed late Secretary and Treasurer. Some of the younger managers, who had been fortunate in obtaining the places of their old members, had seen their way to connect themselves with the Association. But there were still a number in the district who might join them; and if they saw their way to do so, he was sure that the Waverley Association would go on prospering in their hands—knowing, as he did, the superior education and the practical training in chemistry which they now received. He hoped they would excuse him saying more, as they were to have an informal discussion, and were also to consider the proposal of the North British Association as to the standardizing of meter unions. He hoped that their proceedings would be beneficial and enjoyable to all.

Mr. T. Wilson (Coatbridge) said he was sure the members were all very much indebted to their worthy President for his address; and though it did not contain much matter for discussion, he thought he was entitled to their thanks. The President spoke of being a Manager "in a small way." Well, he had been a Manager in a small way himself; and he considered that, if a man was to understand the manufacture and distribution of gas thoroughly, he must go through the "small way" first. As to meter unions, he might say that the Committee of the North British Association had communicated with all the kindred Associations in Great Britain on the subject, and it had been decided that Mr. Carlow should read a paper upon it at the meeting of The Gas Institute at Belfast in June. The subject would then be thrashed out; and he thought it would be in the interests of gas companies and corporations if it could be secured that a uniform size of couplings should be adopted.

Mr. W. B. M'Lusky (Selkirk), the Secretary, said that, since Mr. Wilson had mentioned meter unions, he might read at that stage the circular he had received from Mr. Carlow. In it he said: "I shall esteem it a favour if you will lay this circular and relative reports before your Association at as early a date as convenient; and, in the event of the proposal being favourably received, I would suggest that a Sub-Committee from your Association should meet with other representatives, in London or at some other convenient centre, when the whole subject could be fully discussed."

Mr. W. Blair (Haddington) said in his opinion it would be of great advantage to all gas companies and corporations, and also to meter makers, if they had standard sizes. He thought the initiative should have come from the makers years ago. When a meter was going wrong, if he had not a union to suit it he hesitated to take it out; but if he had one which was interchangeable, he would have it out at once. He might, in that way, save nearly 2s., as compared with having to get another meter. He hoped that at the meeting of The Gas Institute something definite would be done.

Mr. J. Richmond (Dunbar) endorsed what Mr. Blair had said; but expressed the opinion that they should have a standard height of meter as well as a standard size of union, because he had seen a meter fixed where another maker's meter would not fit. Nevertheless, it would be a vast improvement to have a standard for meter unions.

Mr. A. Bell, sen. (Dalkeith), pointed out, with reference to Mr. Blair's remarks, that the meter makers started in business, and made their own patterns, long before these things were thought of; and their businesses had grown as gas-works had grown. He had had a good deal to do with this matter; and, instead of requiring to force them, the meter makers had been in hearty agreement with the Committee. The makers had actually paid for the standard unions. The only thing they said was: "Give us some certainty of finality; do not have us altering our standards again." It was not only the couplings they had to alter, but they had to keep immense stocks; and if there was no finality in the matter, a new set of unions coming out, perhaps in a year or two, would be troublesome, if not ruinous, to them. The whole of the hitch which had occurred had come from their having applied to the Board of Trade. He held that the Board of Trade, whatever moral power they might have, had no legal authority to do anything in the matter. This subject had nothing whatever to do with the measuring vessel. It simply had to do with the connections; and it was for the meter makers and users of the meters to say what sizes they wanted. He was not clear that they should trouble with the Board of Trade, unless they could get them to act freely, giving their moral sanction. The meter makers were ready last New Year to issue the unions, if the Committee had only given them their word that there would be finality; but this they could not do in the meantime.

Mr. Blair said he did not mean to make any reflection on the meter makers, but they knew that in the adoption of the Whitworth standards for iron there had been no compulsion; and he did not see why the same standards should not be made applicable to meter unions.

Mr. D. Vass (Portobello) thought the remarks made by Mr. Richmond were very much to the point. Without a standard height of meters, they would be just left where they were as regarded the changing of meters. He thought they should not do one part and leave the other undone. If the subject was to be taken up by Associations all over Britain, might they not go a little further and communicate with Foreign Associations? They also dealt largely with the home meter trade.

Mr. T. Wilson said that, for their information, he might say that the North British Association had not only adopted a standard pitch of thread, but a standard coupling. He did not know that they should have anything to do with Foreign Associations, because they might come and interfere with them. If it was in the interest of gas companies in England, Scotland, and Ireland to adopt a standard union, it would surely be to the interest of foreign companies and corporations to do the same. In Coatbridge, he changed from 500 to 600 meters every year. Those standards would save him money; and if they were to be a saving to a little town like Coatbridge, they must effect a much larger economy in big places like Edinburgh and Glasgow.

Mr. R. S. Carlow (Arbroath) said he could assure them that the Committee of the North British Association devoted a great deal of time and attention, not only to the height, but to the form and the shape of the couplings. They would be uniform all through.

Mr. J. Renfrew (Langbank) asked if the couplings would be interchangeable.

Mr. A. Bell replied that Nos. 3 and 5 were interchangeable; but No. 2 was not with either. The reason for this was that a No. 3 would suffice for the lighting of a house, but if a small stove were put in, it would not be so then, unless with a larger meter; and they had made the coupling to fit a larger pipe than would be required for the lighting. To make meters uniform in height was a separate question from the unions. Meter makers held patent rights, patterns, and everything else, according to their own ideas; and to ask them all to make their meters according to one size, would be tantamount to asking them to throw up their businesses.

Mr. A. Yuill (Alloa), referring to the "Transactions" of the North British Association of two years ago, said he found that the size of the 2-light meter coupling was $\frac{1}{2}$ inch; and of the 3 and 5 light meters, $\frac{3}{4}$ inch. So that, in changing from a 2 to a 3 or 5 light meter, an alteration would require to be made; but in changing from a 3 to a 5 light meter, it was patent to everyone that it was simply a case of connecting on. He thought the Association ought to take the initiative in the matter, and place it in the hands of their executive to watch over the proceedings—more especially the proceedings at The Gas Institute meeting in Belfast this year. In this way, they would lend a hand in having the unions standardized. He had no doubt but that, if it were taken up, these couplings would be used largely

all over the kingdom; and as to trying to enlist the foreign trade, he did not think they ought to insist upon that at all. Abroad they dealt with the metric system; and he did not think they should encourage anything which would help the introduction of articles "made in Germany." If the meter makers found it was going to be advantageous to them to increase their trade abroad, they would find ways and means of doing it.

Mr. BLAIR moved that the matter be remitted to the executive of the Association, to do what they could towards the attainment of the end in view.

Mr. J. RICHMOND seconded the motion.

Mr. A. SCOTT (Markinch) asked permission, not being a member of the Association, to say how pleased he was to hear the subject of meter unions spoken of as it had been. The manner in which it had been treated was a guarantee that it was only a question of time when the unions would be adopted. Was it necessary that they should have the sanction of the Board of Trade? Seeing that both that Association and the North British Association were unanimously in favour of standardizing the unions, he thought there was really nothing to hinder their universal adoption.

Mr. A. BELL thought it was well that they should thoroughly understand the position of the Board of Trade. The Board, as the members all knew, had power over the measuring vessel. Meters were now under the Weights and Measures Acts. Consequently, the Board of Trade had power over the body of the meter. But this was a question only of the connections, over which, he believed, they had no power. The Board of Trade could not say what sized pipe they were to attach to the meter. But some members of the North British Association thought they should apply to the Board of Trade in this matter; and this was carried at a meeting. The Committee, while they thought it unnecessary, were agreeable, and applied; and it was only then that the hitch occurred. It was after the North British Association had adopted the couplings, and had purchased the standards and paid for them, that the Board of Trade sent down a set of couplings from London, which had been lying on their shelf for ten years, and said they proposed to adopt them. Their Secretary wrote to the official of the Board of Trade who had to do with the matter, and asked if he would kindly refer to the law which gave them power to enforce their standards. The reply they received was that there was no law, but that they were thinking of getting one. These unions were still lying in Edinburgh. They were very good, but they were not like theirs. They had a special thread—not what could be called a common thread. While they would be uniform, there would be just as many couplings as now. There was a universal thread—the Whitworth—for iron; and this was the thread the North British Association had adopted. With it as the thread of the meter unions, if anything went wrong they might be able to repair it themselves, as they would have their iron thread at hand. This was one great advantage they would have if the North British unions were adopted.

Mr. VASS thought this question led them to the subject of the sizes of pipes inside buildings, which he considered was one that the Associations might take up. House proprietors ought not to be permitted to put in pipes which were too small.

Mr. RICHMOND remarked that this was a matter for each Local Authority to deal with. They did so in Dumbarton, where the Corporation told those who were erecting houses that unless they put in certain sizes of pipes they would not be supplied with gas.

Mr. RENFREW said that in Paisley the Corporation had printed regulations to the same effect.

Mr. BLAIR reminded the members that some years ago the North British Association issued a circular with regard to standard sizes of pipes. This was all very good, so far as regarded new houses; but in towns where gas had been in use for sixty years it was very different. In many instances they found nothing but ¼-inch pipes. He had had occasion to send through a ⅜-inch pipe gas for ten or a dozen burners. The members could guess as to the complaints they had in such a state of things. He thought if they were to send round the circular of the North British Association to plumbers and builders, it would do a great deal of good.

Mr. CARLOW remarked that he did not think that plumbers and builders were so much to blame for inadequate piping as architects, who cared no more for the gas manager than for the man in the moon. They seemed to think that they had all the wit and wisdom in the world.

Mr. W. SMITH (Melrose) thought Mr. Carlow was about right. He had an instance where a new house was being built with twelve or thirteen apartments, and thirty lights, and yet the architect recommended a ½-inch service-pipe.

Mr. T. WILSON thought that Mr. Carlow had struck the nail on the head. If they educated the architects, the matter would be all right. In those towns where they could dictate to the proprietors of houses, they were in a very happy position. In Coatbridge they had no control over the matter. The Company had nothing to do with the sizes of the pipes put in, but had simply to furnish a supply of gas. The smallest pipe they laid was 4½ inches; so they showed the architects that they did not wish to lay small pipes.

Mr. W. B. M'LUSKY said that in Selkirk they submitted a circular to the Dean of Guild Court, and got it approved of. The advantage of this was that, having the approval of the Court, that body called the attention of architects to the fact that the Gas Company would not supply gas unless the pipes were of a proper size. He thought that the matter of the standard dimensions of pipes was just like that of the meter unions. It might be said that it was no use beginning to move in that matter, because they could not interfere with old houses; but they must begin some time, and the sooner the better.

The PRESIDENT concurred with Mr. Carlow, and pointed out that at the last meeting of the Association he said he did not see why plumbers should require to be registered and architects should not. He knew that it was very difficult to induce architects to do as they would like, with regard either to gas or to water pipes. Until they enlightened architects, they would never get gas supplies as they should be. He had to thank them for the discussion which had taken place. He thought Mr. Carlow might rest assured that the Association would do what they could to assist him in endeavouring to get the standard unions adopted.

The remit to the executive was then agreed to.

Mr. BLAIR proposed that Mr. J. M'Laren, of Duns, be elected President for the ensuing year.

Mr. G. TAYLOR (Jedburgh) seconded the proposition.

Mr. M'LAREN accepted office, and returned thanks.

On the motion of the PRESIDENT, seconded by Mr. BLAIR, Mr. M'Lusky was re-elected Secretary and Treasurer.

Mr. W. WHYTE (Penicuik) gave notice that he would move on the next occasion that each alternate meeting of the Association should be held in Edinburgh.

Mr. BLAIR presented the President with the Association's medal, as a *souvenir* of his year of office.

The PRESIDENT returned thanks, and expressed the special pleasure he would have in looking back on the fact that he reigned over that Association in the year of the Diamond Jubilee of Queen Victoria.

This concluded the meeting.

The members of the Association and their friends then visited the works of Messrs. J. Milne and Son, Limited, adjoining. In the meter-shop there was an interesting row of meters on a shelf, containing thirteen specimens of meters of ancient design; one of them being a horizontal-dial wet meter eighty years old. There was just completed a photometer for a gas-works in Kent, containing some late improvements—such as Mr. O'Connor's patent adjustable meter, as described by him at the North British Association meeting in Edinburgh two years ago, in which barometric and temperature variations may be eliminated; and also a pressure indicator recently patented by him which works by means of water in the periphery of a wheel. In another part of the works, there was seen under construction a station meter of 80,000 cubic feet capacity per day, for the Perth Gas-Works. Composite dry meters, in which the lower part is of cast iron and the upper part, containing the index, of tin, were also seen in course of construction. The engineering shops were visited; and in them some large orders under execution were explained to the visitors. Thereafter brassfounding and finishing were shown—everything being seen in process, from the making of the alloy to the burnishing of the finished article.

Messrs. Milne and Son afterwards entertained the visitors to light refreshments. Brakes were in readiness, and a drive of nine miles, to Queensferry, was enjoyed. Dinner was served at the Hawes Inn—Mr. M'Laren being in the chair. Here the company were joined by Mr. J. M'Gilchrist, of Dumbarton, who expressed regret that he had not been able to be with them earlier in the day. A short toast-list was gone through rapidly; and then those who cared to avail themselves of the opportunity mounted the steep ground behind the hotel, and were permitted to walk the entire length of the Forth Bridge. Mr. Hunter, the Superintendent of the Bridge, accompanied, and explained the points of the structure. The experience of holding on by the parapet while express trains rushed past within a couple of feet of them was new to nearly all of the visitors, and proved sufficiently thrilling to form the subject of comment on the way back to Edinburgh, which was not reached till after nine o'clock; the gathering having thus lasted, in all, eleven hours. The company dispersed hurriedly in a heavy shower—happily the first which had fallen during the day—in Princes Street.

OHIO (U.S.A.) GASLIGHT ASSOCIATION.

Annual Meeting at Cleveland.

The Fourteenth Annual Meeting of this Association was held at Cleveland (Ohio), on the 16th and 17th ult.—Mr. W. C. BOYLE, of Salem, the President, in the chair.

The President delivered an Inaugural Address, in which he said that though the demand for light was increasing, so was the demand for cheapness. He instanced several ways in which things were "cut fine" in other industries, from which he drew the lesson that gas men must study economy. Had they the best appliances and material, and were they getting the best results? Were the bye-products sold to the best advantage, and was leakage reduced to a minimum? These questions were vital ones; and the answers should be furnished by carefully and regularly kept statistics. The consolidation of several small companies under one central management was advantageous, as enabling a better and more uniform supply of

gas at a reduced cost of production and delivery. Unrestricted competition was all very well; but it was too often carried to the extent of annihilation, and a consolidation of interests was the only escape from insolvency. But the advantages gained by consolidation must not be abused; and the duty of the new corporation to the public must not be lost sight of in the advantage of the situation. A selfish course might result in large profits for a time; but it would lead the municipal authorities concerned to exercise their rights, and to the introduction of rival combinations in the district. A more liberal course would win the respect and support of the consumers, and induce them to hesitate before taking any action that would cripple a friendly company, or involve the city in debt on an uncertain venture. Municipal control of lighting plants had received a severe check by the action of the city of Philadelphia, which, after owning and operating a 500c-million plant for many years, had let the same on lease to a private Company for thirty years; thus acknowledging inability to compete with private management. He thought a comparison throughout the country would show that private companies could work cheaper than municipalities, and that economical municipal control of gas-works was not possible under the existing political system. But a sentiment in favour of municipal ownership was abroad, though supported by few cogent reasons, and nothing in favour of the consumer; and they must be prepared to meet it. There should be a regular Standing Committee of the Association to watch these and similar matters, and report the results of their study at each meeting. They were wofully lacking of statistics in Ohio; and he would like to see official returns showing the quantity and description of coal carbonized, the make and quality of gas, yield of bye-products, &c. The low state of the tar market was an important question, which he hoped would be assisted at the meeting.

A paper on "How to Avoid Competition in a Small Town" was read by Mr. E. G. Schmidt, of Sandusky. After running for more than thirty years as a gas company, his Directors bought up an electric arc-light plant in 1885. A few years later, a natural-gas company came into the district; and about this time they tried a cheap fuel-gas scheme, which proved a failure. To compete with the natural gas, they reduced the price from 6s. 8d. to 4s. 2d. per 1000 cubic feet. But after trying this for three years, they found it hopeless to attempt to compete with natural gas at 1s. 0½d. per 1000 cubic feet for fuel purposes; and as it was not a serious competitor for lighting, they raised the price to 5s. 3d. per 1000 feet. The demand being under 20 millions per annum, they lost money by selling at 4s. 2d. The supply of natural gas failed last year; and they then tried to meet the demand for a cheap fuel gas, by supplying gas for day consumption at 3s. 4d. per 1000 cubic feet, measured through separate meters. The natural gas company were now applying for a franchise to manufacture and distribute fuel gas; and if successful, they would be a serious competitor with his Company. The fact that they already had pipe-lines laid in the streets was in their favour. Turning to the general question, he thought the installation of many municipal plants or opposition companies could be traced to carelessness or short-sightedness on the part of the original company. There were always promoters and introducers of new schemes on the look out, ready to take advantage of any opportunity. The majority of councillors or aldermen wished to see fair play; and if the company had a good case, they would be as likely to get justice from a city council as from any other tribunal. In his own town, a complaint as to the illuminating power of the arc lamps was successfully met by taking the Committee to the works, and being fully open and candid on the matter. Complaints from the council should receive careful attention; and every endeavour should be made to meet their wishes and keep right with them. If this did not secure their friendship, try to gain their respect by fighting them; as they would have more consideration for a company that showed fight, than for one that gave in at the first show of opposition. In the present instance, his Company did not intend to allow the competing scheme to be established without showing some resistance. They had circulated pamphlets on the failure of fuel-gas plants, and endeavoured to explain that, though competition might bring a little temporary benefit, it would in the end raise the price of both gas and electricity. And in the treatment of individual consumers, he endeavoured to remember the golden rule, and insisted on uniform politeness, consideration, and liberality in the settlement of disputes. No company could expect to have the support of the public if their service was inferior in any way. In towns of less than 30,000 inhabitants, gas and electricity should combine, as there was no room for competing companies, even with the strictest economies. Companies operating a combination plant could give a better service at lower rates than when subject to competition, which might be the life of trade in some lines, but did not do for public companies in small towns. The end to be sought was ability to give good service at prices that would neither invite competition nor furnish arguments in favour of municipal ownership.

The paper excited a great deal of interest. In the course of the discussion, Mr. G. H. Christian asked whether an ordinance of a city council for the extension of a franchise already existing—as, for example, when a fuel-gas company having a franchise for fuel gas only, asked to have the same extended to include illuminating gas—required a two-thirds or a mere majority vote. The President thought a two-thirds vote would be required; and Mr. Persons cited a case which supported this view. Mr. J. B. Stevenson said that at Van Wert the electric light company had a contract to furnish arc lights of nominal 2000-candle power. An expert retained by the Council reported that the lights did not exceed 400 candles; and on this the Council declared the contract null and void, though it had seven years to run, and also had not paid the bills. Mr. E. S. Templeton understood that the "nominal" candle power was the photometrical value multiplied by four, and that a 2000 nominal was an actual 500 candles. He quoted a rough comparison of a Welsbach light and an electric arc light, which showed only four to one, or about 250 candles, for the latter. Mr. Cline could not see why a gas-light should be measured at the actual value, and an arc light at four times that amount. Mr. Jenkins said that the expert who reported only 400-candle power should have been forced to produce his experimental data. He had some investigations made at Covington last year, by an expert who came from Cincinatti, which caused a lot of trouble; but he had not much difficulty in showing that the expert knew very little about the matter, and that his report was not reliable. Mr. Witherby said that the rule for estimating the candle value of an arc lamp adopted by Professor Houston and other authorities, was to adjust the current to 48 volts and 9·6 ampères. This would give a nominal 2000-candle power lamp. In practice, it was impossible to maintain a constant length of arc; and the longer the arc the greater the voltage. By reason of irregularities in the mechanism of each lamp, the photometrical power would vary; but if a current of 9·6 ampères, with an average of 48 volts, to each lamp were maintained, this would be legal proof that the lamps were 2000-candle power nominal, and the committee could be compelled to pay for them as such. The arc lamp was subject to variations from so many different sources, that it was very difficult to get the actual photometrical value. Each lamp in the series would affect all the others, so that it was impossible to depend upon the light remaining constant even for half a second. In a first-class lamp the carbons were never still, and the longer the arc the greater the voltage, and the higher the illuminating power. Mr. Lathrop said that Professor Houston recently made some photometrical tests of the nominal 2000-candle arc lights in the streets of Columbus, with a portable photometer; and the average result was 1065 candles. Mr. Holmes thought the real question was whether the nominal 2000-candle lamp averaged that amount, or only 500 candles as they understood it. With regard to the acknowledged variations, what was the limit of those variations? He had heard Professor Thomas say that he had tested carbons from almost every lighting company in the State, under the regular voltage and ampèrage previously named, and that the photometrical value was anywhere between 800 and 2200 candles; and he had suggested that more attention should be paid to the carbons. Mr. Butterworth said the paper contained valuable advice. By treating the consumers fairly and honestly, they would be prevented from wanting other companies to come in; and by selling at the lowest possible price, the incentive to competition was removed. But if the opposition did come, then, as a last resort, there was combination.

Mr. Schmidt, in replying, said he supplied not only electric light, but power; and that at Sandusky—a city of 20,000 inhabitants—he represented the only source from which light or power could be obtained. Consolidation was attended with a reduction of establishment and other expenses. The actual power of an arc lamp could not be accurately valued by the photometer; and he believed the rule was to supply 450 watts to the lamp, and call that 2000-candle power. In the case he mentioned, he did not attempt to prove the illuminating value, but showed that he was maintaining the proper supply of electricity, using good carbons, and doing all in his power to live up to the terms of the contract. He had not heard of anyone who could measure arc lights accurately by the photometer.

A paper entitled "The War of the Incandescents: Gas *v.* Electric," was read by Mr. J. H. Maxon, of Gallipolis. He treated the subject from the point of view of one who sells gas only. While the incandescent gas-burner was a failure in the hands of the tradesman who cared for nothing beyond the first profit on the sale, it was a success when the gas company took up not only the sale, but the repair and maintenance. There should be a good show-room, where all kinds of burners and shades were on view; and careful instruction should be given to every buyer as to the proper way of using the burner. It could be shown that incandescent gas-burners were more effective and less expensive than electricity. The difficulty of sweating in shop windows, which only occurred in cold weather, could be met by thorough ventilation, or by placing the gas-burners near the top; and the bye-pass arrangement rendered them as convenient as electricity in the matter of turning off or on. In most cases, he could show a large increase in efficiency at a less expense. Under ordinary circumstances, the cost of renewals, with mantles at 2s. 1d. each and chimneys at 5d., would be 5d. per burner per month; but in saloons, restaurants, and other places where the lights might be roughly handled, it would be more. He advocated pilot lights and adjustable air-tubes, and said the best rule was to adjust the burner to the lowest rate of pressure. The question of repairs and maintenance was very important, as a burner out of use but in full view on the fixture was one of the worst enemies they could have. It was a mistake to induce consumers to attend to renewals of

mantles, &c., as this should be done by experienced persons accustomed to the work, who should blow out dust, and adjust the flame, &c., at the same time. It was well to keep to the best makes only, as there were incandescent burners on the market that were a discredit, and likely to injure their business.

Discussion being invited, Mr. G. T. Thompson agreed heartily with the author that the placing of the incandescent burners should be undertaken by the gas companies, and that they should use only the best makes. It would be well if the employment of the incandescent gas-burner for street lighting was also considered in the discussion. Mr. Booth instanced some cheap incandescent burners retailed at 9½d. each, which gave a good effect at first, with natural gas; but their durability was very limited. Mr. Stevenson had lately introduced Welsbach burners for street lighting at less than one-third the cost of the arc lamps; and he thought the mantles would average two months each. Mr. Jenkins said that, in his experience, six mantles per lamp per annum were not enough for street lighting. But anti-vibrators and other improvements were to be introduced; and he believed there was a great future for the system. The President said that the difficulty was that people let the lights get into bad condition, and not caring to pay the cost of renewals, would persist in using them, which acted as a bad advertisement for the gas company. In self-defence, therefore, they were often obliged to do something in the way of renewals gratis.

(To be continued.)

RESERVOIR EMBANKMENTS, WITH SUGGESTIONS FOR AVOIDING AND REMEDYING FAILURES.

At a recent Meeting of the Society of Engineers, a paper on the above subject was read by Mr. W. Fox, M.Inst.C.E.

In introducing the subject, the author explained that during his professional career he had had frequent opportunities of studying the construction of reservoir embankments, having carried out several works of this description, in some of which temporary failure had been experienced, causing much anxiety and trouble, though the remedies applied were in all cases ultimately successful. He first made some general remarks on the subject, and then went on to describe instances where difficulties had arisen, and the means adopted to overcome them. He said he proposed to confine himself to embankments constructed across natural valleys, thereby forming storage reservoirs of greater or less magnitude; this being recognized as the most economical mode of storing water for town supplies. In his general remarks, the author dealt first with the depth and form of the foundation for the puddle trench, and the material used for refilling it; and, secondly, with the form of the embankment, the material used, and the mode of construction.

I.—Depth and Form of the Foundation for the Puddle Trench.

Even when a suitable site, from a geological point of view, has been obtained, failure may occur through the foundations for the puddle wall not being taken sufficiently deep, not only in the bottom of the valley, but also into the slopes on either side. The author knows of no theoretical rule whereby, having regard to the hydrostatic pressure to which the work is to be subject, the proper depth into the solid ground can be determined; everything depending upon the closeness or water-tightness of the material in which the excavation is made. In one instance within the author's knowledge, the material for the foundation being boulder clay, the excavation was only taken 5 or 6 feet below the surface of the ground; and though a certain amount of moisture is visible beyond the outer slope of the embankment, the reservoir has been constructed for a number of years, and is to all appearances satisfactory. Such a shallow depth of excavation is, however, not to be recommended, and especially in boulder clay, where beds of gravel may be met with, and where the only sure guarantee for safety is to take the excavation to a very much greater depth.

An absolutely impermeable foundation can probably never be obtained. Springs, more or less, even in clay, will be found; and only experience can determine when these are in such a position or of such insignificance as to be considered harmless. It has been the author's practice, if water appears in the bottom in quantities exceeding a mere weep, to put in a thick layer of concrete, on which the puddle rests. This has the effect of preventing running water coming in contact with the clay. He has also found it advisable to lead springs away by means of vertical pipes placed on one side of the trench, so as to enable the concrete to set without loss of cement. These pipes have in some cases been brought up to the level of the surface of the ground, and, if the water rises in them, continued to the outer slope of the embankment; in others, when it has been found that the water ceases to overflow, they have been run with cement grout and plugged.

The width of the trench is a question on which a great variety of opinion exists. The author considers that, if it is to be refilled with good clay puddle, from 8 to 10 feet is sufficient for any depth up to 80 or 100 feet below the top water-level; and for comparatively low pressures of 20 to 25 feet, 6 feet will be enough—of course, provided the clay is of good quality. Where the trench is to be refilled with concrete, a width of 6 feet will suffice to avoid any possible risk of failure.

In several cases where trenches of great depth have been constructed and the water pressure to be encountered was very great, it has been found most expedient not to fill the trench with clay puddle, but with good hydraulic concrete. This material, when once it has set and become hard, is not acted upon by running water; and, if properly made and of sufficient thickness, it is perfectly water-tight. As a matter of cost, much will depend upon the facility for procuring suitable material and the price of hydraulic lime or cement; but though a less thickness is required, and a saving is effected, not only in the material of the filling, but also in the excavation of the trench, it usually turns out more expensive than puddle.

Though good fresh-burned blue lias lime, ground before slaking, makes excellent concrete, it is more usual now to substitute portland cement. The greatest objection to hydraulic lime is its comparative slowness in setting, and the difficulty often experienced in getting lias lime uniform in its chemical components, and sufficiently finely ground; but, on the other hand, if disturbed during the process, provided the lime is not washed out, the concrete will reset or 'grow—a property which portland cement does not possess. If lime is used, the author usually makes it in the proportion of one part of lime to four or five parts of broken stone and sand, measured by bulk. For puddle trenches of the dimensions previously mentioned, the author makes portland cement concrete in the proportion of one part of cement to five or six parts of broken stone and sand; or, if there is much water in the trench, it may be advisable to increase the proportion of cement to make up for the possibility of some being washed out.

II.—Form of Embankment, Material Used, and Mode of Construction.

The author believes that invariably in this country, although elsewhere the method is departed from, it is usual to render the embankment water-tight by a wall or core of clay puddle brought up from the trench previously described. The designing of this part of the embankment is a subject of greater diversity of opinion than any other. The author's experience has been to bring the puddle up to within a foot of the top bank-level, where it is 8 or 9 feet thick, and increase downwards with a batter of 1 inch per foot on each side, so as to be 18 or 19 feet thick at 61 feet below the top bank-level. An instance will be referred to later on where, having had to cut into and remove some of the puddle wall, it was found to be quite sufficient; the wall being entirely impervious to water even with a pressure of 50 or 60 feet, though the clay obtainable for puddle was far from being of the best possible description.

The height between the top bank-level and the top water-level, of course, depends upon the depth that the water is calculated to run over the waste weir, and the estimated height of the wave which may be formed by the wind blowing down the reservoir, having regard to the length of reach and the position of the embankment with reference to prevailing winds. In the author's opinion, this height, even with small reservoirs, should never be less than 4 feet after the embankment has done settling; and with large reservoirs, 6 to 8 feet may be desirable.

The width of the top of the embankment is not, in the author's opinion, so material as the width at top water-level, which is governed by the distance between the top water-level and the top bank-level and the slopes to which the embankment is to be constructed. Assuming these slopes meet at the top bank-level at the centre line, the top water is 5 feet below the top bank, and the slopes 2 to 1 on the inside and 3 to 1 on the outside, the width at top water-level will be 25 feet. This will leave ample protection to the puddle to prevent cracking in dry weather, for, if not protected, it may become a source of danger.

It is convenient that the embankment should be at least 10 to 12 feet wide at the top. This may be obtained either by making the slopes above the top water-level somewhat steeper, or, instead of their joining at a point at the top bank-level, designing them any convenient distance apart, or adopting a combination of both arrangements. In addition to this, the author has, in two instances where the reservoirs have been made in the lias clay, formed the lower part of the toe of each slope of dry rubble or burnt ballast, with very satisfactory results. The inner slope of the embankment is, of course, always protected from wash by dry rubble pitching, brick, or concrete.

The author has found that clay spread in layers about 8 or 9 inches thick, well watered, twice cut and trodden, gives a very satisfactory result, though it is necessary sometimes to use tempered clay in the trenches on account of the difficulty of cutting and treading the clay between the timber used for supporting their sides. The author believes that the mode he has described is cheaper than tempering the clay beforehand; but it is not so expeditious, as the latter system permits of clay being dug and tempered at such times as are convenient, and when the weather may be unsuitable for other progress being carried on. The author requires those parts of the embankment nearest to the puddle to be made of the finest and most argillaceous material obtainable, and put in in 2-feet layers; the most stony material being retained for the outer parts of the slopes, which may be put in in 4-feet layers, the layers being concave towards the centre of the embankment.

It generally happens that in districts in this country where

large storage reservoirs are being made, the rainfall gives sufficient water to consolidate the material as it is put in place; and though it is desirable that the material should not be too dry, if it is watered artificially it should be very carefully done, in order that the whole may get an equal quantity of water.

In the construction of the embankment, it is the author's practice to set the profiles of the slopes somewhat steeper than the slopes are eventually intended to be, and to finish the top somewhat higher, in order that when settlement takes place the embankment will assume the shape intended. The amount of this allowance must depend upon the height of the embankment, the time taken in its construction, and the character of the weather prevailing.

The author will now describe a few instances within his experience where difficulties have occurred, and the steps which were taken to render the work satisfactory. He will also cite an instance where these difficulties were anticipated, and describe the methods adopted, which successfully prevented failure.

Den of Ogil Reservoir, Forfar Water-Works.

The embankment of this reservoir is placed across a narrow glen or gorge, the length being 310 feet and the greatest height 60 feet. The greatest depth of water is 50 feet. Trial holes were sunk before the work was commenced, in order to arrive at some idea of the depth it would be necessary to excavate for the foundation for the puddle trench. At the south end of the trench, rock was met with at about 7 feet below the surface, and near the bottom of the valley, on the same side, and less than 100 feet off, another trial hole disclosed rock at about 5 feet from the surface. It was concluded that between these points the rock would be found at no great depth; and the contract depth for the trench was fixed at this part at from 25 to 30 feet from the surface. On opening the ground a totally different state of things was discovered, for between the two points a deep bed of gravel was found, and the excavation had to be taken down as much as 80 feet below the surface before the rock was met with. The arrangement for discharging the water from the reservoir is by a 24-inch pipe laid in concrete, which was bedded on rock for almost the whole length; a short distance only at the outer and inner ends being upon hard gravel. The valves for regulating the flow were placed at the outer end.

The work was commenced in May, 1879. By September, 1881, the trench had been excavated and refilled, and the puddle wall and embankment carried up some height. With about 26 feet of water in the reservoir, a leakage appeared around the discharge-pipe at the outer slope of the embankment. To ascertain the cause of this, a heading was driven from the outer end alongside the concrete which surrounded the pipe, to the concrete foundation of the puddle wall. Water was met with coming through the concrete surrounding the pipe, and it was expected that the pipe had been fractured. This was not, however, the case. The concrete showed no sign of fracture; and when some of it was removed to get at the pipe, the leakage was discovered to be running through the concrete,

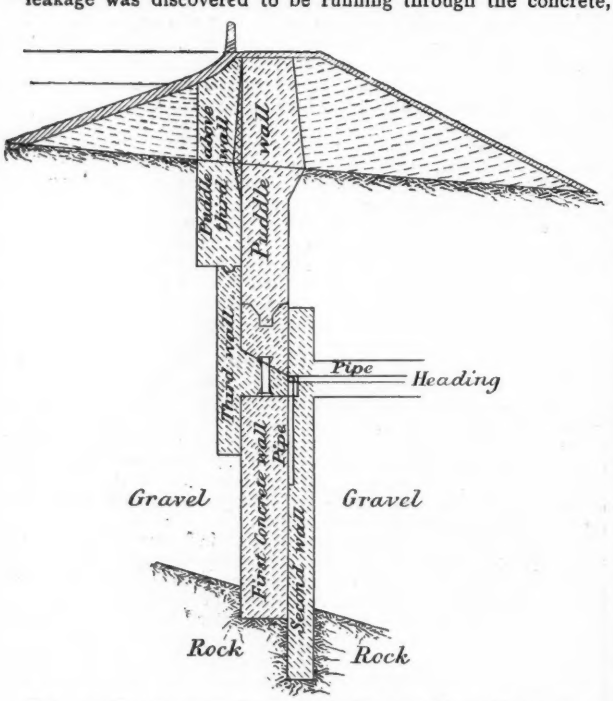


Fig. 1.—Transverse Section of Den of Ogil Reservoir.

which was much honeycombed, and, although set very hard, was imperfectly put in place. This was not the only source of leakage, for at the end of the heading water was seen coming up outside the concrete foundation of the trench. To follow and locate this was the only course to pursue. A shaft was sunk from the top for ventilation and for facilities for moving the material, and a second trench was sunk outside the original one. (See fig. 1.) At the deepest part, this was taken a little farther than the original foundation, as it was found that a small flow of water was coming through the rock underneath the foundation on the reservoir side; but by far the greater proportion of the leakage was coming through the concrete, which in places was very badly and carelessly put in.

When it was thought that the faulty part of the concrete was all exposed, the second trench was refilled with concrete; the face of the first wall being scored both longitudinally and horizontally with deep grooves to form a tie between the two, and to prevent water following along. The concrete for the original and all subsequent work was formed of one part of portland cement and five parts of broken stone and sand—no stone to exceed 1½ inches in size. The specification required that the concrete should be spread in 8-inch layers, and not thrown loosely into place. From what subsequently transpired, however, it is doubtful whether this was done in the original work. The cement was tested in the usual manner, and found to be satisfactory.

Although the greatest care was observed in refilling the second trench, the result was not entirely successful. When the second wall had been taken up to within about 6 feet of the top of the excavation, the reservoir was allowed to fill; and in February, 1883, with about 39 feet of water in it, the leakage from all sources amounted to more than a million gallons per day. Several pipes had been put in during the construction of the second wall, in order to convey any leakage to a basin at the outer slope of the bank, from which it could be sent to Forfar, or down the stream as compensation, as might be desired; the intention also being to be able to control the leakage, when collected in these pipes, by means of stop-valves.

The bulk of the leakage was from a pipe which had been placed vertically between the two concrete walls, with an open end at a spot where the first wall was leaking badly; and there was also a large quantity of water springing up between the two concrete walls. A pipe which was brought up from the bottom on the outside of the second trench, and which was laid to take any leakage which might come underneath from the reservoir, yielded very little water; and the leakage from this source did not increase to any great extent as the reservoir was filled. The result of this work was to collect the leakage and utilize it for the town supply. As time went on, the leakage also diminished in quantity until in June, 1883, it was about 354,000 gallons daily, with water 30 feet deep in the reservoir. This quantity compared with 590,000 gallons, the amount a few months previously with the same reservoir pressure.

The valves on the pipes conveying the leakage already referred to were not put on; it being feared that the result of stopping the flow would be to cause the leak to burst out elsewhere, and possibly at a level from which it could not be conveyed into the pipe to the town. The headings were left open, and the filling of the reservoir continued, in the hope that the leakage, which was all, or nearly all, coming through the concrete, and was perfectly clear, would gradually decrease.

In September, 1883, a fresh leak occurred; the water coming through the concrete of the first wall near its junction with the puddle; and though the quantity was insignificant, it was much coloured—indicating a probable waste of the puddle. The water in the reservoir at this time was 44 ft. 6 in. deep, or within 5 ft. 6 in. of being full. When the water-level was reduced to 44 ft. 2 in., the leakage ran clear. The level was then kept at about 42 feet, at which the leakage from between the two walls was reduced to 233,000 gallons per day. By the end of 1883, the leakage from between the two walls had further decreased; and the small leak discovered in the previous September had not increased, though at times the water was discoloured. Early in 1884, the last leak became again discoloured, and a slight settlement in the embankment was seen on the surface.

It was then decided that a further remedy must be resorted to. A shaft was sunk on the inside of the puddle trench to the level of the top of the concrete foundation. In sinking this shaft, a large cavity was discovered about 15 feet from the surface in the original ground, which doubtless to some extent accounted for the settlement, as well as for the discoloration of some of the leakage. When the shaft had reached the top of the concrete foundation of the puddle wall, a trench was excavated alongside it similar to one which had been made on the outside, and taken down to a depth of about 25 feet. This excavation disclosed much faulty concrete. Though in places it was close and water-tight, in others it was so open that water when poured in ran away freely. When the excavation was taken down to the depth stated, it was decided not to go deeper, as the second wall put in would arrest any leakage that might come through the first below that level. The excavation which had been taken beyond the 24-inch discharge-pipe, so as to cut off the water which was known to follow along the concrete surrounding that pipe, was then refilled with concrete to a little above the level of the old concrete foundation; and, in order to ensure a thorough connection being made with water-tight work, it was connected through the first wall to the second, as shown. This connection was made by cutting out the first wall bit by bit, in lengths of 9 or 10 feet; and as each section was taken out the wall above was supported by a cast-iron pillar about 6 feet long, and the concrete put in and allowed to set before the next section was commenced. By this means the concrete connection was

made without the slightest settlement appearing in the first wall or in the puddle above. The whole of the ground above the top of the third wall was then cut open from the surface, and refilled with puddle and concrete; thus entirely cutting off those parts of the original concrete and puddle through which leakage had appeared in such a form as to cause apprehension.

The headings from the outer slope to the concrete foundation of the puddle wall, and along the top of the second wall, had been kept open all this time, and remained so until January, 1887, when the reservoir was full and overflowing for the first time. The only leakage that was then visible was coming from the pipe which had been fixed between the original foundation and the second wall put in, the bottom end of which was below the concrete connection that had been made between the second and third wall, and therefore not affected by the construction of the latter. The leakage from this source amounted to about 135,000 gallons per day; and as the water was perfectly clear, and there was no apprehension of a further increase taking place, the headings were filled up. From that date to the present time, everything has been satisfactory; and with the reservoir full in April, 1892, the leakage from all sources had decreased to about 30,000 gallons per day.

It will thus be seen that from September, 1881, to June, 1885, or for nearly four years, the work of discovering and remedying these leaks was going on. Many delays arose through having to make alterations in the mode of proceeding; and though the work was not of any great magnitude, progress was slow on account of its having to be carried out in a confined situation and step by step. It may be suggested that the work on the outside of the puddle wall might have been dispensed with, and that a new wall on the inside would have been cheaper and more effectual, besides effecting a saving in time. But it was only by sinking outside the puddle wall that the leakage could be located and the effect of filling the reservoir could be noticed; and when the trench was sunk, it was obviously better to refill it with concrete than with earth or loose rock. The author considers that the whole cause of the trouble was due to the concrete being carelessly put in.

It is worthy of remark that in no other part of the work where concrete was used was there any sign of failure. This particular part of the trench was refilled just before the frost of 1879-80 set in; and it may have been in the hurry to get the concrete done that the carelessness arose. Be that as it may, the author never wishes to have to undertake again such a tedious operation as discovering and remedying a leak which occurs somewhere in work buried from 70 to 80 feet underground.

Dowdeswell Reservoir, Cheltenham Corporation Water-Works.

This reservoir is on the River Chelt, about four miles above Cheltenham, and is situated on the lias clay. The Cheltenham and Banbury Railway follows the hill on one side of the valley in which the reservoir is constructed. At the time the reservoir was designed, in 1882, great trouble had been experienced in the embankments of this railway, owing to the ground under and adjacent to them yielding, and the banks slipping. It was therefore evident that, unless some unusual course was adopted, difficulties would arise.

The reservoir embankment is 730 feet in length, and 39 feet in height to the surface of the ground as it then stood. But this was, in the deepest part, 17 feet above the original surface of the ground; the valley at this point having been the site of an old mill dam, which through disuse had become silted up. Trial holes in this silt showed it to consist of very fine oolitic *débris* and clay, with a large percentage of water, giving it the appearance of very fine running sand. After the water was drained off, it was naturally much firmer. But it was thought, before it was removed, to be unfit for the formation of the embankment; and it was therefore decided that it should be run to spoil.

The material available for forming the embankment was chiefly lias clay of a very treacherous nature. There was, however, a limited amount of oolitic gravel found within the site of the reservoir, which was available for forming the outer part of the slopes. These on both sides are 3 to 1 (see fig. 2), with the exception of the top 6 feet of the outside slope, which is 2 to 1. The 3 to 1 slope on the inside is taken down to 16 feet below the

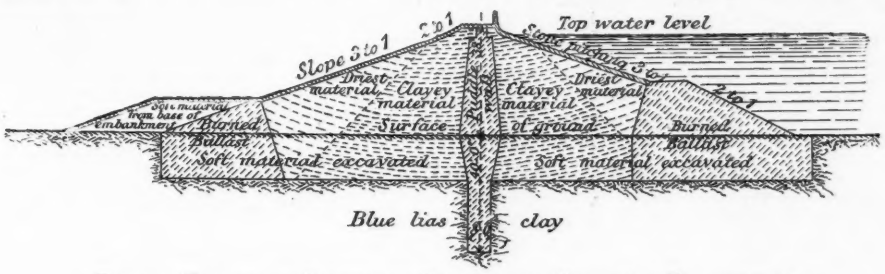


FIG. 2.—TRANSVERSE SECTION OF DOWDESWELL RESERVOIR EMBANKMENT.

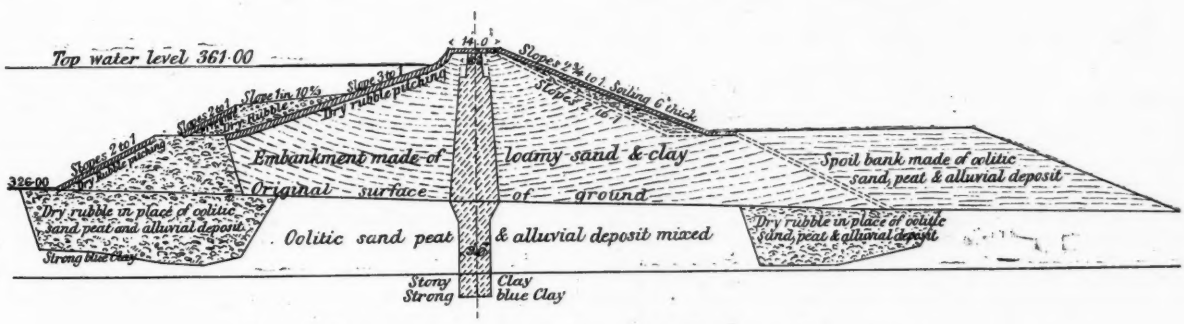

Top water level 361·00
326·00
Embankment made of
Original surface
of ground
loamy sand & clay
Spoil bank made of oolitic sand, peat & alluvial deposit
Dry rubble in place of oolitic sand, peat and alluvial deposit
Oolitic sand peat
& alluvial deposit mixed
Strong blue clay
Stony Strong
Clay blue Clay

FIG. 3.—TRANSVERSE SECTION OF MONKSWOOD RESERVOIR EMBANKMENT.

[The dotted lines show the embankment as originally designed.]

top water-level, where there is a bench 15 feet wide. The whole of the toe across the valley to this level is formed of burnt ballast. The outside slope is 2 to 1 for the top 6 feet, and then 3 to 1 to 22 feet below the top water-level. At this level a burnt ballast toe commences, which is kept within the 3 to 1 slope. Beyond the 3 to 1 slope there is a bench formed by the soft material excavated from underneath the base of the embankment. This bench is 35 feet wide, and terminates against the original ground with a 3 to 1 slope. It was originally intended to burn the lias clay obtained from the inside of the reservoir to form the burnt ballast; but it was found that the silt from the base of the bank, after it had time to drain, burnt into excellent ballast, forming clinkers sometimes several tons in weight. It was burnt *in situ*; thus saving the expense of conveyance to the position where it was to be used.

Although during construction the embankment settled downwards to a considerable extent, there have never been any signs of lateral movement. The work has been completed about ten years, and has shown no signs of failure. It may, therefore, be fairly assumed that the precautions taken have been proved to be successful.

Monkswood Reservoir, Bath Corporation Water-Works.

This reservoir is situated partly on the upper lias formation and partly on the oolitic sand; the puddle trench being entirely in the lias clay. Along the centre of the valley across which the embankment has been made a deposit of oolitic *débris* and peat was met with, varying in depth up to 17 or 18 feet. This, of course, was removed on the line of the puddle trench, in order to obtain a water-tight foundation; and under the outer halves of both slopes of the embankment it was also removed and refilled with rubble stone, to avoid its squeezing and oozing out by the superincumbent weight of the embankment to be placed upon it. In the main puddle trench a few small springs were met with in the lias clay; but these were either cut through or else kept back by cement concrete. In the oolitic sand in the arm trench on the north side of the reservoir, a good deal of water was also from time to time met with, though it was, no doubt, to a large extent due to surface water running off the hillside beyond.

The material at hand, though much of it was excellent for puddle, was of a most difficult character to deal with in the formation of the embankment on each side of the puddle. To

guard against the possibility of slipping, the toe of the inner slope, for a width of about 55 feet, and for a height of about 18 feet, was formed of dry rubble, which, with the rubble filling below, made a total maximum depth of stone of about 38 feet, and a maximum width of about 75 feet. (See fig. 3.) The rubble was thus brought to 20 feet below the top water-level, where it terminated in a berm 20 feet wide. Beyond the outer slope, a spoil-bank of peat, excavated from the inside of the reservoir, was formed. The material for the embankment was rendered worse by the very bad weather which prevailed during the first winter the works were in progress. The clay became exceedingly slippery, and the oolitic sand, which was quite dry and easy to handle in summer, became almost running sand in wet weather. The difference in the specific gravity of this material when wet and when dry was very marked; a cubic foot when measured dry and loose weighing about 63 lbs., whereas a cubic foot when wetted and pounded weighed 116 lbs. It was in consequence of this that, as the embankment approached completion, there were evident signs that it would not stand at the slopes originally designed—viz., 2 to 1 on the outer, and 3 to 1 on the inner slope.

At this time the puddle wall was within a few feet of its full height and the embankment on each side was practically taken to the top bank-level; the last 8 or 10 feet having been put together with practically no moisture to consolidate it, except the surplus water from that used in making the puddle wall. The consequence was that the puddle, which was much heavier than the earth on each side, settled down to an abnormal extent, and probably squeezed into the earth, causing a slight sign of bulging on the outer slope above the top of the peat spoil-bank. This was remedied by bringing some stony material from an adjacent quarry and placing it on the outer slope, flattening the slope to $2\frac{3}{4}$ to 1. Before this had been completed, however, the pitching on the inner slope, just above the rubble toe, also showed signs of lifting. The rubble toe below was unmoved; and from the form that the pitching took, it was evident that the toe had not moved, but was doing its work by upholding the earth behind it. It was then decided to weigh the 3 to 1 slope with rubble. When this was done, the embankment was completed without difficulty, though it continued to settle vertically for some time. This settlement is probably not even yet completed.

The author attributes these difficulties to the great difference in the material forming the puddle wall and the earth used for the bank, aggravated by the latter being put together practically without moisture. He thinks the surplus water from the puddle only made matters worse, as it was not distributed evenly through the embankment. He is of opinion that in this instance a judicious use of water on the bank might have had a good effect, especially as the slope of the cutting from which the material was taken stands at $1\frac{1}{2}$ to 1.

Gas-Engines for Driving Dynamos.—Mr. H. J. Rogers, writing to the "Electrical Review" in reply to a correspondent who asked for particulars of gas-driven plants, states that he has erected a large number of gas-engines for electric lighting, and in almost every case—certainly in 19 out of 20—he has driven the dynamo direct from the engine without the intervention of the countershaft.

The Colour of Water.—A report on the colour of water by M. Kemna, of the Antwerp Water-Works Company, has been recently reprinted from the "Bulletin de la Société Belge de Géologie," and it is noticed in a recent number of "Nature." In it the views of various writers, from Arago downwards, on the physical, chemical, and organic causes of the different colours of different waters, are summarized. M. Kemna indicates the practical bearing of these investigations on the testing of water supplies of towns, and describes different methods of applying tests. Those known as the Hazen tests, and due to Mr. Allen Hazen, of Massachusetts, find most favour with the author.

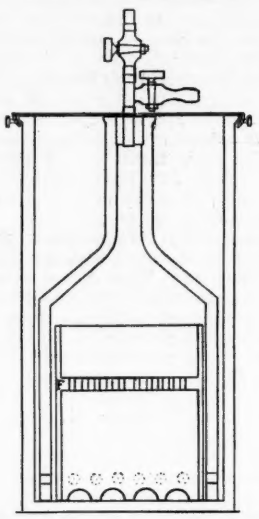
Eastern Counties Gas Managers' Association.—The spring meeting of the Association is to be held at Peterborough to-morrow. The members will assemble at the Grand Hotel for light luncheon, and afterwards proceed to the Guildhall, where, by the kindness of the Mayor and Corporation, the meeting will be held. The programme is a light one. In addition to the formal business (which includes the election of nine new members), a paper on street lighting is to be read by Mr. E. C. Sayers, the Gas Inspector of Ipswich; and this will be followed by a discussion on the desirability of standardizing meter unions. The members will conclude the day by dining together at the hotel already mentioned.

Institution of Mechanical Engineers.—The next ordinary general meeting of the Institution will be held at the Institution of Civil Engineers on the 27th and 29th inst., under the presidency of Mr. S. W. Johnson. The business will consist of the delivery of the Inaugural Address by the President, and the reading and discussion of papers. It may be remembered that at the meeting last February (*ante*, p. 399), a preliminary report presented to the Gas-Engine Research Committee by Professor F. W. Burstall, of Birmingham, giving the results of a series of trials carried out by him, was partly discussed. At the forthcoming meeting, he will submit a supplementary paper, and the discussion will be continued. The anniversary dinner of the Institution will be held at the Freemasons' Hall on the evening on the 28th inst.

REGISTER OF PATENTS.

Producing Artificial Light.—Wigham, J. R., of Dublin. No. 4125; Feb. 16, 1897.

This invention refers to a method of applying hydrogen gas to ordinary incandescent burners, "so as to give to persons living in districts in which coal gas is not available, an opportunity of obtaining the intense light of incandescent burners in the form of portable or of permanent lamps."



The apparatus (as shown) is made of earthenware, and consists of three pieces: An outer cylinder, closed at one end, to contain the exciting fluid, by preference dilute sulphuric acid; a cylindrical receptacle for granulated zinc, having perforated openings half way for that purpose and archway openings at the bottom; and round this cylindric receptacle an inverted bell-shaped receiver, with outlet at the top, and suitable valve and outlet-pipe for the exit of the gas. The whole is so constructed that, when the light is turned off, gas making ceases. On the outlet-pipe is placed a burner for conveying the gas to an incandescent mantle on a burner, but without the usual bunsen bottom.

The second part of the invention relates to apparatus of similar construction (but not necessarily of earthenware) for the production of acetylene gas from calcium carbide, to be burned in any suitable burner.

Controlling Valves and like Apparatus from a Distance.—Kerr, W. of Harlesden. No. 6449; March 11, 1897.

This invention relates to the operating or controlling of gas and other valves, electric switches, and the like, from a distance by means of momentary increments or decrements of fluid-pressure. The main object is to provide a device of this kind which will operate efficiently, with either high or low pressures, for dealing with railway carriage lighting.

The patentee has an actuating piston or diaphragm, working in a cylinder, combined with step-by-step mechanism, so arranged that it will be moved in one direction when subjected on one side to increased fluid-pressure, and in the reverse direction when the pressure is diminished, or a vacuum or partial vacuum is created in the cylinder on the same side of the piston or diaphragm. This piston or diaphragm and the step-by-step mechanism are preferably so constructed and arranged that the gas-valve or the like connected with the mechanism will be moved in one and the same direction, whether it is actuated by increased pressure or by a vacuum.

Igniting the Charges of Gas-Engines.—Rowden, W. T., of Lenzie, N.B. No. 7074; March 18, 1897.

This ignition-valve for gas or oil vapour engines—especially motors that revolve at high speeds or use slowly-burning mixtures, such as air and producer gas, or air and blast-furnace gas—has a connection between the interior of the ignition-tube and the external air, by means of a hole through the plunger. At the proper moment, the ignition-piston is caused to travel rapidly outward—thus closing communication between the ignition-tube and the outside, and opening communication between it and the compressed charge, part of which rushes in, is heated, inflamed, expanded, and discharged by its increased pressure into the main body of the compressed charge.

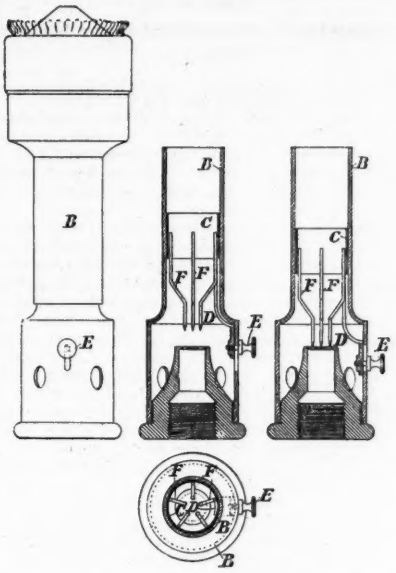
Adjusting the Blue Flame in Incandescent Burners.—Fusshöller, F., of Siegburg, Germany. No. 7342; March 20, 1897.

This is an "appliance for the quick and proper adjustment of the blue flame in gas-light incandescent burners, characterized by a number of needles, firmly connected with each other, corresponding to the number of the holes in the nozzle of the burner, and arranged above the nozzle and moveable on it upwards and downwards, so that the points of the needles enter more or less in the holes of the nozzle, and consequently symmetrically narrow or enlarge the holes."

The illustration shows an exterior view of the mixing tube of a burner, on the burner-head of which is seen the blue flame of the lighted gas and air mixture, "the simple and proper adjustment of which is to be realized or intended." Also longitudinal sections through the mixing, tube without the burner-head; the regulating appliance in one case lifted and accordingly inefficacious, and in the other drawn down and consequently working. There is also a cross section of the burner-tube.

In the lengthened mixing-tube B, serving at the same time as a guide,

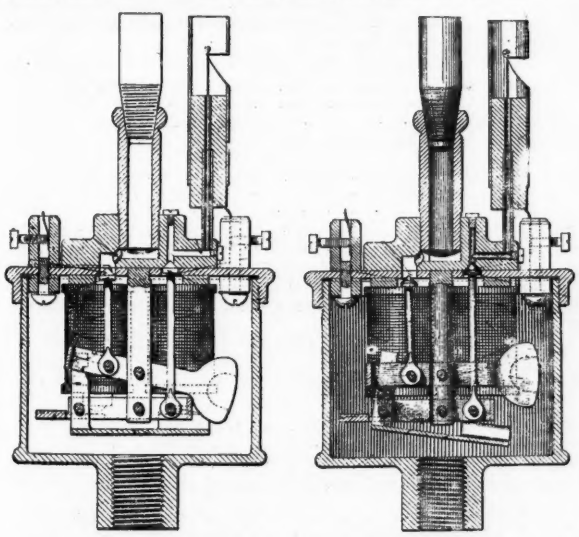
moves an exactly adjusted cylindrical slider C, which can be moved up and down with the handle E by means of the tie-rod D. On the slider are provided needles F in a number and position corresponding to the number and position of the holes in the gas-nozzle. The needles have at their lower end conical points, and are joined together by means of the slider



C, and held in such a position that all the points of the needles simultaneously and equally enter in the openings of the nozzle, when the slider is let down. At the side of the mixing-tube between two air-holes, is a small slit, in which a screw connected with the handle E is guided, and can be fastened at any height. When the slider is drawn down, the points of the needles enter into the holes of the gas-nozzle—narrowing the escape of the gas, and so regulating it.

Gas Lighting and Extinguishing Apparatus.—Kerridge, J. H., of Beccles. No. 9968; April 21, 1897.

A particular feature of this invention, according to the patentee, is that he does not require to employ any constantly burning bye-pass flame, and is also able to keep the small platinum wire which effects the primary igniting out of the flame excepting during the period of ignition.



One or two bye-pass flames (but preferably two) are employed, in order to keep the igniting-coil out of the flame when the lamp is burning. The igniting wire or coil (as shown) is arranged in proximity to a bye-pass flame, which is sufficiently far away from the lamp flame to prevent the wire from being kept at an unduly high temperature while the lamp is burning. The second bye-pass flame is lighted from the first one, and both are extinguished when the lamp is burning. The turning on and off of the gas, and the igniting of the bye-pass flames and extinguishing them, may be accomplished by the following electric devices: The gas-valves are arranged preferably at the base of the burner; one controlling the two bye-passes, or the single bye-pass if only one be used, and the other controlling the main flame. The valves are opened and closed by means of two electro-magnets, and suitable armatures, levers, &c. The electro-magnet which is first energized attracts its armature; the current also passing through the igniting-wire. The armature, in its movement, opens the bye-pass valve, and an automatic catch engages with the arm which controls the main gas-valve. The bye-pass flame lights at the igniting-wire, and passes its flame to the second bye-pass for the main burner; and the current is then discontinued. The armature falls by its own weight, or under the influence of a spring; and, in doing so, it opens the main gas-valve and closes the bye-pass. These two movements are so timed that the main flame is ignited before the bye-pass is extinguished.

To extinguish the lamp, the other electro-magnet is energized; and in attracting its armature, it releases the arm which controls the main valve, and this arm (in falling), by its own weight or under the influence of a spring, closes the main gas-valve, and the light is extinguished. The parts remain in this position until the first magnet is again energized, when the same cycle of operations is repeated.

The illustration shows a sectional elevation of the burner provided with the controlling mechanism; also the position of the mechanism after the gas has been turned on and ignited.

Dry Gas-Meters.—Simpson, S., of Exeter. No. 10,662; April 29, 1897.

This invention consists in the arrangement of the measuring chamber of a dry gas-meter diagonally, and longitudinally divided by a fixed partition; and in the arrangement of the moveable diaphragm discs upon vertical rods or spindles disposed in the smallest angular recess of each of the triangular chambers so formed. Thus, upon the alternate ingress and egress of gas, the discs partially and alternately rotate upon their respective vertical spindles, "with the effect of operating the index mechanism and passing the gas through the meter in definite measure in the usual manner of a dry meter." The diagonal disposition of the respective diaphragms is said to afford a maximum capacity of measurement; while "the fixture of the respective moveable diaphragms to the vertical rods or spindles, whereby the motion of the discs is positively communicated to the index mechanism, together with the means for positively determining the movement of the respective moveable diaphragm discs, ensure the constant measurement of definite quantities of gas and ready means for the precise calibration of the meter."

FIG. 1.

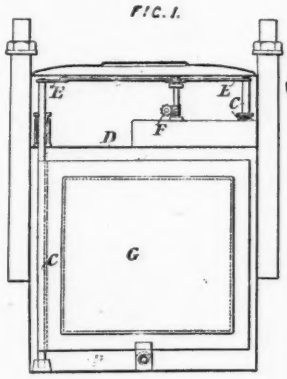


FIG. 2.

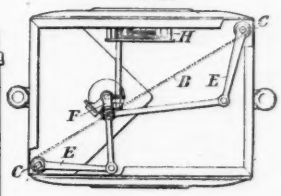
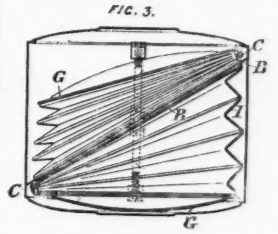


FIG. 3.



The illustration shows: A sectional elevation of such a meter; a plan, in which the meter cover is removed; and a sectional plan of the casing through the measuring chamber, in which one diaphragm is shown in section, the other in plan.

The measuring chamber of the meter is divided by a fixed diagonal partition B, forming longitudinal chambers of triangular shape. Into the smallest angular recesses of each of these, a vertical rod or spindle C is mounted within a stuffing-gland provided upon the partition D that transversely divides the casing, so as to form the measuring chamber and valve and index chamber respectively. Levers E are screwed to the upper extremities of the spindles C, and are connected to a tangent F by means of links, one of which is longer than the other to suit the usual disposition of the index and valve mechanism. Diaphragm discs G are fixed to the main portion of the spindles that traverses the respective measuring chambers; and they are caused to partially rotate or vibrate upon the spindles C, upon the alternate ingress and egress of gas—regulated by valves operated in turn on the partial rotation of the discs. This causes the operation of the index mechanism by means of a worm provided upon a shaft rotated by the levers and links E F, and a worm-wheel provided upon the unit spindle of the meter-index H.

The flexible diaphragms I are made of leather, linen, cotton, or other suitable material (treated so as to be impervious to gas), preferably of bellows form, collapsing regularly in alternate ridge and furrow folds; being precluded from deformation on any variation of pressure by the provision of stiffening plates internally and externally. For the purpose of ensuring a constant measure of definite quantities of gas and the ready calibration of the meter, stops are provided for determining the movement of the respective moveable diaphragms G; each set of stops being mounted upon right and left handed screws, whose adjacent extremities are retained in position within a block fixed within the partition B, by means of pins engaging in recesses upon the opposed extremities of the screws. The screws are arranged centrally upon the bottom plate of the meter, and are provided with square extremities projecting so as to be capable of operation on each side of the meter; and after fixture of the stops into position, the screw ends are covered with a seal of wax at each side to prevent fraudulent adjustment. It will be readily understood that, upon the operation of either of the screws, the respective stops are caused to recede or approach; so determining a relatively large or relatively small movement of the diaphragm discs.

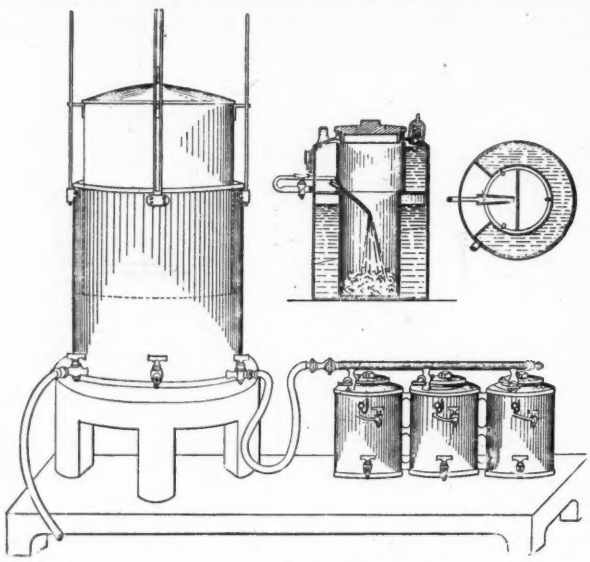
Gas Cooking-Stoves.—Pringle, R., of Blackheath. No. 17,835; July 29, 1897.

This invention relates to improvements in connection with the gas cooking-stove forming the subject of a previous patent, No. 8405 (*ante*, p. 712). The improvement has particular reference to the provision of additional and external burners for heating vessels placed upon the stove; also to the supply to the burners of gas which has been previously heated by passing through a heat regenerating pipe or chamber traversing one

of the flues of the stove; and, further, to the utilization for supporting the combustion of this gas, of the hot air coming from the interior of the cooking-stove, so that not only is the heat of the escaping air utilized directly for heating the vessels placed over the burners, but also for effecting the complete combustion of the "regeneratively heated gas" at the burners at the same time that "the vapours issuing from within the stove are deprived, by contact with the external flames, of all odour of cooking."

Producing Acetylene Gas.—M'Conechy, J., of Glasgow. No. 24,301; Oct. 21, 1897.

The illustration shows a range of three acetylene generators and a vertical and horizontal section of one of them. Each generator consists of an upright cylindrical casing, the top of which is of dome configuration, with an opening therein provided with a lid in order to give access to the interior. Occupying the upper internal position of the casing, and three-fourths or thereabouts of its circumference, is mounted a tank or well open at the top. A pipe leads from the bottom of the tank outside of the casing, where it describes a bend, and returns again into the inside of the generator, at a point left unoccupied by the ring-like form of the tank. The lower outside edge or inner diameter of the tank is formed with a lip to support telescopically a vessel or container, whose upper edge is provided with a corresponding outer lip or flange resting upon the inner lip of the tank. Small pivoted catches retain the



vessel in position, and prevent it rising with the buoyancy of the water contained in the producer. Within the vessel the charge of calcium carbide to be treated is placed (as shown); being weighed or otherwise proportioned so that the water contained in the tank is sufficient to decompose it, and no more.

On the lip of the container is mounted an adjustable hinged shoot or trough, which can be turned up into a vertical position when the vessel is to be withdrawn; but when in the normal position shown, it lies freely in an oblique position across the top of the container. The outlet end of the pipe from the tank is so arranged as to lie immediately over and discharge itself into this trough; and when the water is turned on, it runs down the trough and falls centrally among the crystals to be treated. The acetylene produced escapes by a pipe leading from the dome of the generator, and is conducted by a pipe common to the whole series into the holder.

APPLICATIONS FOR LETTERS PATENT.

8016.—Thompson, W. P., "Acetylene lamp." A communication from H. Sez. April 4.

8030.—Söhnel, A. E. R., and Zehner, A. R., "Acetylene gas apparatus." April 4.

8039.—Bamford, S. B., "Explosion engines." April 4.

8051.—Lavelly, A., "Gas-grills." April 5.

8064.—Legge, J. St. C., "Acetylene gas-lamp with generator." April 5.

8072.—Hahn, T., "Automatically lighting and extinguishing gas-lamps." April 5.

8137.—Rylin, E. A., "Gas-burners." April 5.

8147.—Kelly, C., "Generators for acetylene gas." April 5.

8156.—Holt, H. P., "Lubricators for gas-engines." April 5.

8173.—Temple, H. E., "Acetylene gas-generator." April 6.

8177.—Ashworth, J. B., "Acetylene gas-lamp." April 6.

8181.—Renouf, P. L., "Gas-motors." April 6.

8254.—Grubb, Sir H., "Production of acetylene gas." April 6.

8258.—Abbey, F., "Igniting and extinguishing gas-burners." April 6.

8287.—Herriot, H. E., "Combined atmospheric burner and mantle and chimney lifter or bearer." April 7.

8321.—Bradnock, J., "Gas-chandeliers." April 7.

8355.—Imray, J., "Regenerative gas-furnaces." A communication from F. Siemens. April 7.

8382.—Lake, H. H., "Production of acetylene gas." A communication from J. Grand. April 7.

8399.—Geizl, J., and Landau, S., "Producing acetylene gas." April 9.

8402.—Gibson, W. I., "Gas-engines." April 9.

8406.—Bishop, H. S., and Robinson, H. L., "Suspending mantles and other articles in hot gas-flames." April 9.

8439.—Stott, J., "Generating and storing acetylene gas." April 9.

8469.—Knapp, E., "Igniting and extinguishing gas-flames from a distance." April 9.

CORRESPONDENCE.

[*We are not responsible for the opinions expressed by correspondents.*]

Mr. George Livesey and the Management of The Gaslight and Coke Company.

Sir,—The time has not come, and I am not sure that the columns of the "Journal" are the right place, for a rejoinder to the "Reply" to my criticism of the Chartered Company at their last meeting. The "Reply" is addressed to the shareholders, of whom only a very small proportion can be reached through the "Journal;" and as to your readers, a large proportion of them are able to form their own opinion of the position and working of the Company in question without the assistance of either Colonel Makins, Mr. Field, or myself.

I must, however, in the general interest, deal with one point, not referred to in the remotest degree in my speech, which the compilers of the "Reply" have introduced. I refer to the question of gas testing, which has surely been the cause of so much worry to all three London Companies that I should have thought, in their own interest, they might have let this "sleeping dog" lie. A short quotation is made from a very lengthy report of the then Chemist to the London County Council, dated June 8, 1894, which occupied several pages of the "Journal" of the 10th of July in that year. The report I need hardly say was not directed as the reference to it in the "Reply," and the extract given, make it appear, solely against the South Metropolitan Company; but the other two Companies come in for a share in the general attack. I prepared a reply, on behalf of my Board, which was sent to the Council; and at the same time a copy was sent to you, and published in the "Journal" on the 17th of July. In that letter, signed officially by our Secretary, and in the other letters I have written to the Council and to the "Journal" (from some of which quotations are made in the "Reply"), I felt, and still feel, that while defending the South Metropolitan Company I was not acting in the slightest degree antagonistically towards the other Companies, but, on the contrary, was fighting their battle quite as much as our own. I think, therefore, to say the least, it was unwise of the Governor and the General Manager of the Chartered Company to unnecessarily reopen the question of testing. It can by no possibility do their Company any good, and may do them harm. Moreover, by separating these quotations from their context, and entirely ignoring my answers and arguments, they have given an erroneous impression, and, as I shall show, have made a most inexcusable mistake.

The short quotation, on p. 32 of the "Reply" and on p. 837 of the "Journal," from the County Council report, is introduced for the purpose of showing that, in the number of testing-places, the South Metropolitan Company were specially favoured; while the inference drawn from this statement is one with which I will not deal further than by simply saying it is not worthy of the Directors (for the whole Board have, I suppose, adopted the "Reply") of a great Company. The comparison of the number of testing-places of the three Companies in relation to the output of gas is based on figures that are utterly wrong; and to me it is inconceivable how Colonel Makins, and especially such an Accountant as Mr. Field, could have adopted them.

The relative daily output of the three Companies is given as follows:—

Gaslight	53 millions!!!
South Metropolitan	36 ,,
Commercial	5½ ,,

which give the following ratio of testing-places:—

Gas'ight	1 to 3½ millions.
South Metropolitan	1 ,, 6 ,,
Commercial	1 ,, 2¾ ,,

But there is a mistake in the main figures, which was fully exposed in our letter of July 14, 1894. The writer of the report took the *maximum* daily output of the South Metropolitan Company, which he compared with the *average* daily output of the two other Companies. Such a mistake might be excusable in his case, but not so in that of those who have repeated the error.

Turning to the tables in "Field's Analysis" for 1893, I find, on p. 16, that the compiler has given a special table on this point. There is a column headed "Maximum Daily Delivery," in which for the year 1893 the figures stand thus—

Gaslight	114,727,000 cubic feet.
South Metropolitan	36,672,000 ,,
Commercial	10,811,000 ,,

These figures give the ratio of testing-p'aces thus—

Gaslight	(15 or) 1 to 7½ millions.
South Metropolitan	(6 or) 1 ,, 6 ,,
Commercial	(2 or) 1 ,, 5 ,,

Or if it is taken on the *average* daily output (which is certainly more reasonable), the figures are as nearly equal as possible—

Gaslight	1 to about 3½ millions.
South Metropolitan	1 to about 3 ,,
Commercial	1 to nearly 3 ,,

I am sorely tempted to deal with other points in the "Reply," but must refrain. This, however, is, I hope, sufficient as a sample, and will, I trust, convince your readers that *even the figures*, to say nothing of the statements and arguments and the quotations, without their context, cannot, without verification, be relied upon to prove the case of the compilers of the "Reply."

Possibly I may have to trouble you again later on; but at present I will conclude by saying that I shall not allow this matter to sink to a mere personal dispute. The real question is the position of the greatest Gas Company in the world; and if, as I contend, that position is most unsatisfactory, everyone interested in the gas industry must desire the restoration of the Company to as high a condition of prosperity, with as low a charge for its gas, as is possible, and none more so than,

Yours truly,

April 14, 1898. George Livesey.

The Working of The Gaslight and Coke and South Metropolitan Gas Companies.

SIR,—The following comparisons may be of interest to those of your readers who are devoting any attention to the controversy which is now proceeding between the Chairmen of the two leading Metropolitan Gas Companies:—

In 1877, the selling price of ordinary gas by the Chartered Company was 3s. 6d. per 1000 cubic feet, and by the South Metropolitan Company 3s. 2d. per 1000 cubic feet—a difference of 4d. in favour of the southern Company. In that year the former placed £30,641 to the reserve fund; and the latter, £5318 to the insurance and reserve funds.

In 1897, The Gaslight and Coke Company's price to private consumers averaged 2s. 9·70d. per 1000 cubic feet; and the South Metropolitan Company's, 2s. 3d.—a difference of 6·70d. per 1000 cubic feet in favour of the southern Company, which would be reduced to 6d. by allowing 0·7d. per 1000 cubic feet for meter-rents abolished since 1877. The former Company were obliged to withdraw £83,874, or 0·94d. per 1000 cubic feet, from their reserve fund; the latter Company having a small surplus to carry forward.

It therefore seems that The Gaslight and Coke Company, despite the larger increase of consumption in their district (11,393 millions, as against the South Metropolitan's 8045 millions), have not been able to achieve such admirable results in twenty years as the smaller Company; completely falsifying the generally accepted belief that the greater the production the more economical the cost of manufacture, &c.

As the difference of 2·94d. per 1000 cubic feet in the results of 1897 as compared with 1877, represents more than £250,000 per annum against The Gaslight and Coke Company, it is hardly surprising to find that the Administration of the Company has been unfavourably criticized and attacked. Possibly the outcome of it all will be beneficial to the shareholders, and not least to the long-oppressed consumers.

April 16, 1898. G. T.

Absorption of Water by Coke.

SIR,—In reply to Mr. Lyon's letter in the "JOURNAL" for March 29, regarding my remarks on wet and dry coke in my "Gas Engineer's Pocket-Book," I feel I can add but very little to what I have already stated. I have been carrying out some experiments with Scottish coke, which contains a much higher percentage of ash than that made from Newcastle or Durham coals; and I find that this coke will easily absorb from 10 to 12 per cent. of water. I have unfortunately not had an opportunity of trying this with coke made from Newcastle coals, at the present time; but from experiments made some years ago, I do not consider the 20 per cent. which is stated in my book as at all overstepping the mark.

I know of one works where the coke is sold by weight to the Railway Company, and by measure to the local purchasers; and, curiously enough, that sold to the Railway Company is always taken from outside, and certainly in wet weather the purchasers must be paying for some water instead of fuel. I consider the old woman mentioned by Mr. Lyon distinctly smart; and I feel sure he will agree with me, if he takes a quantity of dry coke, weighs it, leaves it in the open during a heavy shower, and then weighs it again while wet.

Edinburgh, April, 9, 1898. HENRY O'CONNOR.

Darlington Corporation Gas and Water Supply.—At the last monthly meeting of the Darlington Town Council, a report by Mr. J. Hepworth, M.Inst.C.E., on the storage capacity of the gas-works was presented by the Gas Committee. Mr. Hepworth says that a storage of 100 per cent. as compared with the maximum daily delivery of gas is absolutely necessary; and he advises that there is no method by which, under present circumstances, a proper supply can be maintained without incurring the expense of a new gasholder. He is confident that this expenditure will in the end prove to be at once the most satisfactory and the most economical. The consideration of the report was deferred. The reports of the Gas and Water Committees on the past year's working were also submitted. Mr. Marshall, in moving their adoption, mentioned that the profits of the gas-works for the past year were £535 less than in the preceding twelve months. The Water Committee, he said, supplied manufacturers with 9½ million gallons of water more than in the previous year. This showed that trade in the district was in a very prosperous condition. The consumption of water had been 279½ million gallons, or 1½ million gallons more than before. They had supplied 8¼ million gallons less for domestic purposes, and, curiously enough, had received £93 more for it. The reports were adopted.

Exmouth Gas Company.—At the recent annual general meeting of this Company, the accounts presented showed that, after providing for all fixed charges, there was a balance of £1687 to the credit of the profit and loss account. Out of this the Directors recommended a dividend of 10 per cent. on the original shares, and 7 per cent. on the ordinary shares, free of income tax, after payment of which there would be a sum of £1047 to carry forward. The make of gas last year was 32,113,200 cubic feet; being an increase of 5,227,800 cubic feet on the production of 1896, or equal to 19·4 per cent. The total number of meters in use on the 31st of December was 964, of which 800 were ordinary and 164 automatic. The increase for the year was 81 ordinary and 86 automatic. There were 264 gas-cookers in operation—179 with ordinary, and 85 with automatic consumers; being an increase of 56 for the former and 61 for the latter. Owing to the increased demand for gas, it has been found necessary during the present year to erect a new purifying-house and to enlarge the purifiers, condensers, and scrubber; also to convert the present purifying-house into a coal-store, the existing coal accommodation being insufficient. The Chairman (Mr. J. Palmer), in moving the adoption of the Directors' report, mentioned, as evidence of the successful year lately completed, that at the close of 1896 the balance of the revenue account was £905; whereas at the end of 1897 it was £1333. The report was adopted. Authority was subsequently given to the Directors to raise additional capital to the amount of £3000 by the issue of preference shares, to enable them to carry out the improvements above referred to. The proposed new purifiers will be capable of passing 300,000 cubic feet of gas daily, as compared with 100,000 cubic feet at present. The new works were fully explained by Mr. Willey.

LEGAL INTELLIGENCE.

JUDICIAL COMMITTEE OF THE PRIVY COUNCIL.

(*Before Lord* HOBHOUSE, *Lord* MACNAGHTEN, *and Sir* RICHARD COUCH.)

Johnston and the Toronto Type Foundry Company, Limited, v. The Consumers' Gas Company of Toronto.

This was an appeal from an order of the Court of Appeal for Ontario of June 20, 1896, reversing a judgment of Mr. Justice Ferguson. The arguments were recently heard before a Board consisting of the Lord Chancellor, Lord Watson, Lord Macnaghten, Lord Morris, and Sir R. Couch, when judgment was reserved. This has since been given, and was recently reported in "The Times."

Mr. HALDANE, Q.C., and Dr. A. HOUSTON appeared for the appellants; Mr. DALTON M'CARTHY, Q.C. (of the Canadian Bar), and Mr. A. J. RAM represented the respondents.

Lord MACNAGHTEN, in delivering their Lordships' judgment, said the respondents were incorporated in 1848 by an Act of the Parliament of Canada (II. Vict., cap. 14). The preamble stated that the great and increasing extent of the city of Toronto and the large demand for a cheap and effective mode of lighting the streets and places of the city, as well as the houses, shops, and other buildings therein, rendered it desirable that more than one company should be established for furnishing a further supply of gas. It also stated that the Corporation of Toronto had signified their assent to the formation of the Company and to their having the necessary powers connected with the establishment and construction of the works. The appellants, who were the plaintiffs, complained that they had been overcharged by the Company for gas consumed in the business of the Toronto Type Foundry Company, Limited. The appellant Johnston is the Managing-Director of that Company, and the person with whom the contract for the supply of gas was made. The plaintiffs sued on behalf of themselves and all other consumers of gas furnished by the Consumers' Gas Company. They did not name or indicate any particular sum as the amount of overcharge; nor did they suggest that they had paid more than they had contracted to pay. Their case was that the Company had violated or neglected obligations imposed upon them by an Act passed in 1887, and intituled "An Act to further extend the powers of the Consumers' Gas Company of Toronto." They alleged that if those obligations had been fulfilled, some reduction would have been made in the price of the Company's gas. They insisted that the Company's accounts from the date of the Act of 1887 should be reviewed and recast by the Chancery Division of the High Court of Justice; and they claimed that the Company should be declared to be trustees for them of all sums which were found to have been misapplied, and which ought to have been allowed to the plaintiffs in reduction of the price of gas. The Company demurred generally; but the demurrer was ordered to stand over to the trial. In the meantime, the parties agreed upon a special case setting forth a number of figures, which, however, were not to be binding on either party in case the Court should think fit to direct a reference. On the special case and the pleadings, the Court were asked to determine, in the first place, whether the plaintiffs or either of them had a right to maintain the action. In the event of that question being answered in the affirmative, a variety of points were suggested for the consideration of the Court in relation to the Company's accounts and the conduct of their affairs. The Judge at the trial held that the plaintiffs were entitled to relief. He thought the suit properly constituted; and he pronounced a decree containing ten declarations on the points suggested by the special case, and directed no fewer than fifteen separate accounts to ascertain the Company's true position, having regard to the requirements of the Act of 1887. The accounts to be taken would, he said, "necessarily be accounts comprehending the whole business of the defendants done since the passing of that Act, including the surplus profits in the hands of the defendants at the time that Act was passed." The Company took the matter to the Court of Appeal for Ontario. The appeal was allowed, and the action dismissed, with costs. From that decision the present appeal had been brought. It was admitted at the Bar, very properly, that the plaintiffs were not entitled to sue on behalf of other consumers of gas furnished by the Company, and that the action must be treated as brought by them in their individual capacity. The only question argued was whether the Court were right in holding that the plaintiffs had no cause of action. The answer to that question must depend solely on the Act of 1887. It was not suggested that the action could be maintained on any other ground. There was no dispute as to the circumstances under which that Act was passed. The capital of the Company had been increased under the authority of various enactments. It stood at the time at $1,000,000. The dividends had reached the statutory limit of 10 per cent.; and the shares were at a premium. The Company went to Parliament and asked that the capital might be doubled; and they proposed that the additional $1,000,000 should be allotted to the existing shareholders at par. The Corporation of Toronto opposed the Bill on the ground that the shareholders were not entitled to so large a bonus; and they insisted that advantage should be taken of the opportunity to secure a reduction in the price of gas. Negotiations then took place between the Company and the Corporation; and the Act as passed was the result of a compromise. It was not necessary to state the provisions in any detail. Whatever the facts might be, their Lordships assumed, for the purposes of the case, that the Company had not fulfilled their statutory obligations. The Act authorized them to increase the capital to a sum not exceeding $2,000,000; and all new shares were to be sold by auction. All sums received on sales over the par value were to be added to the reserve fund until it equalled one-half of the paid-up capital. The fund was not to exceed that limit; and it was to be drawn upon only for certain purposes specified in the Act. Another fund was to be created and maintained by the Company, to be called the "plant and buildings renewal fund." To it were to be charged "all usual and ordinary renewals and repairs." The Act went on to provide that any surplus of net profit from any source whatever, after the payments therein mentioned, and the establishment and maintenance of the reserve fund and the plant and buildings renewal fund, should be carried to a

special account to be known as the "special surplus account;" and it declared that, "whenever the amount of such surplus is equal to 5c. per 1000 cubic feet on the quantity of gas sold during the preceding year, the price of gas shall be reduced for the then current year at least 5c. per 1000 cubic feet to all consumers." After these provisions, there came a clause which seemed to their Lordships to have an important bearing on the question before them. It was in the following terms:

9.—The Company shall give not less than two weeks' written notice by registered letter to the Mayor of the City of Toronto of the time of commencing the annual audit of the books and accounts of the Company; and it shall and may be lawful for an auditor to be appointed by the Mayor of Toronto, should he deem it advisable to make such appointment, to be present at such annual audit, and, for the purpose of verifying the Company's annual statement, to have access at the Company's office to all books, accounts, and papers necessary for such purpose.

It could not, of course, be disputed that the Company were under an imperative obligation to create and maintain the several funds specified in the Act of 1887 in accordance with the directions of the enactment; nor was it open to doubt that the machinery of the Act was designed for the benefit of all the Company's customers. At the same time, it was to be observed that no pecuniary liability was imposed for default, nor was a right of action expressly and in terms given to persons aggrieved. Now, it was perfectly true, as was observed by Lord Tenterden, that if a statutory obligation was created, but no mode of enforcing its performance was ordained, the common law might in general find a mode suited to the particular nature of the case. (*Doe dem. Bishop of Rochester v. Bridges*, 1 B. and Ad., 859.) But it was equally true that the question whether an individual who was one of a class for whose benefit such an obligation was imposed could enforce performance by an action-at-law, must depend, to use Lord Cairns's words, "on the purview of the Legislature in the particular statute, and the language which they have there employed." (*Atkinson v. Newcastle Water-Works Company*, 2 Ex. Div., 441.) It was especially so, as his Lordship observed, when the Act in question was not an Act of public and general policy, but was rather in the nature of a private legislative bargain with a body of undertakers incorporated for purposes which Parliament considered of public and general utility. They knew the history of this legislation. It was difficult to suppose that the Gas Company would wittingly have consented to place themselves at the mercy of every customer who might fancy he was paying more than the Company were entitled to charge. On the other hand, a Chancery suit, involving all necessary and proper accounts and inquiries, was at best not a handy mode of obtaining redress for a trifling overcharge in a gas bill. Some people might think the cure worse than the disease. At any rate, it might be doubted whether a remedy which was commonly supposed to be neither expeditious nor economical would have commended itself to Parliament as the best way of protecting ordinary householders and shopkeepers from the rapacity of a wealthy and powerful Company. What, then, was the intention of the Legislature? What security was provided to ensure the observance of the statutory requirements? The answer was to be found in section 9. The Company was originally established with the assent of the Corporation. The Corporation were large customers, if not the largest customers of the Company. The ratepayers, therefore, were interested in keeping down the price of gas. On behalf of their constituents and the public, the Corporation came forward to oppose the Bill of 1887. They procured the insertion of clauses designed to cheapen the supply of gas; they obtained authority to check the Company's accounts. They were given the fullest power of investigation; and if they should find the Company wilfully disobeying the Act of Parliament, they certainly would have no difficulty in compelling obedience by process of law. To them, and not to every individual customer who might fancy himself aggrieved, Parliament had confided the duty of seeing that the Act was obeyed. There seemed to be no reason to suppose that the Corporation had neglected the duty which they voluntarily undertook. It appeared by the Company's balance-sheets that in every year except the one immediately preceding the commencement of the action, the Corporation appointed an auditor, who examined, verified, and signed the accounts. The accounts for 1893 were not signed by an auditor on behalf of the city, and no explanation was given of the omission. It might be that the Corporation thought it unnecessary to examine the accounts for that year; or they might have considered it not desirable, as it certainly was not required by the Act, that their officer should give his formal sanction to the Company's accounts. However that might be—whether the Corporation had or had not been remiss—it seemed to their Lordships to be perfectly plain that no individual customer could have a right of action against the Company for non-compliance with the provisions of the Act of 1887. Their Lordships would, therefore, humbly advise Her Majesty that the appeal should be dismissed; and the appellants would pay the costs of the appeal.

Sale of Shares.—On the 7th inst., 55 £10 shares (last dividend 9½ per cent.) in the St. Neots (Hunts.) Gas Company, were sold by auction—20 at prices varying from £20 5s. to £20 17s. 6d.—most of them near the latter figure—18 at £21, 15 at £21 2s. 6d., and 2 at £21 10s.

Extended Use of West's Stoking Machinery.—The Directors of the Folkestone Gas Company have decided to extend their system of stoking machinery, which has now been in operation a number of years, and have accepted the tender of West's Gas Improvement Company, Limited, for a complete installation of stoking machinery for their new retort-house. The Jersey Gas Company have also determined to introduce stoking machinery into their works, and have placed an order with the same firm for an installation of their charging and drawing machinery.

Luton Gas Company.—At the recent half-yearly ordinary general meeting of this Company, continued progress was reported. Owing to the increasing demand for gas, larger mains had to be laid down in several parts of the town. The quantity of gas manufactured last year was 192 million cubic feet. The full dividends were declared. The Directors have resolved to reduce the price of gas to consumers by 1d., to 2s. 5d. per 1000 cubic feet as from Lady-day. The charge to the Corporation for public lamps was recently reduced to 2s. 3d. per 1000 feet. The Engineer and Secretary (Mr. W. R. Phillips) was thanked for his able services

MISCELLANEOUS NEWS.

GASLIGHT AND COKE COMPANY AND THEIR CONSUMERS.

The Increase in the Price of Gas.

Meetings continue to be held to formally protest against the action of the Directors of The Gaslight and Coke Company in raising the price charged for gas in their district. At one of them, convened by the St. Luke's Vestry, Mr. Enos Howes, J.P., presided, and resolutions were unanimously passed seeking protection to consumers north of the Thames, and deciding to oppose the scheme for the conversion of the Company's stocks unless some equivalent is given to the public. Following up the conference at the Clerkenwell Town Hall on the 28th ult. (*ante*, p. 778), a public meeting was held in the same place on the 7th inst., under the presidency of Mr. A. Millward, J.P. Resolutions were submitted in substantially the same terms as those proposed at the conference—asking for a Board of Trade inquiry into the past and present management and working of the Company, with the view of putting an end to the existing anomaly whereby gas consumers on the north side of the Thames have to pay 3s. per 1000 cubic feet as compared with 2s. 3d. per 1000 feet on the south side; and claiming some substantial concession in the form of a reduction in the price of gas if the stock-conversion scheme is to be sanctioned by Parliament. The London County Council were called upon to make every effort to oppose the Company's Bill in order to secure such concession; and the support of the Metropolitan Members was requested to the movement. Some of the speakers expressed the opinion that the suggested processes were too slow; and they submitted amendments. But it was pointed out that success was only to be achieved by strategic steps. A resolution was drafted—presumably for submission to a subsequent meeting—expressing the opinion of the ratepayers that the only remedy for the existing evil is the "public ownership and control of the lighting of the parish," and urging the Clerkenwell Vestry to "proceed as speedily as possible with the proposed installation of the electric light."

THE COVENTRY CITY COUNCIL AND THE HOME OFFICE WATER-GAS INQUIRY.

At the Meeting of the Coventry City Council last Tuesday, the Gas Committee reported that they had carefully considered a letter addressed to the Council by the Secretary of the Departmental Committee appointed by the Secretary of State to inquire into the questions of the manufacture and supply of water gas. The letter asked the Council to express an opinion on the subject; requested any information likely to be of service to the Committee; and invited the Council to instruct some representative or official to appear before the Committee and lay before them the views of the Council, together with such other information as may be in his possession. The Committee recommended that the following information be given to the Committee: "(1) That carburetted water gas has been manufactured at the Corporation gas-works and supplied to the public, mixed with coal gas, since February, 1897. (2) That no accidents have taken place from the use of water gas within the area supplied by the works of the Corporation. (3) That the opinion of the Council, based upon the experience of Coventry, is that the manufacture of water gas should not be interfered with." The Committee did not recommend that any representative or official should at this stage be instructed to give evidence. They, however, suggested that, if the Committee asked for any further explanation or figures, they be authorized to furnish them, and, if necessary, to instruct one of their own members, or the Manager, to give evidence. Alderman Andrews having proposed and Mr. Kinder seconded, the adoption of the report without comment, Mr. West, as one of the residents near the gas-works, did not quite agree with recommendation No. 3. Although he did not like the word "interference," he thought at any rate some supervision on the part of the supreme authorities would not be out of place, as there had been a number of complaints of the water-gas plant since it had been in operation. The report was adopted.

THE SUPPLY OF WATER GAS IN LIVERPOOL.

The recent case of gas poisoning in Liverpool has revived public interest in the subject of the supply of carburetted water gas by the Gas Company, and correspondence has again been freely indulged in in the daily papers. One point on which some of the correspondents appear to have been troubled was as to whether the Company have any legal right to supply gas other than that derived from coal; but a writer signing himself "G. H. B." has removed all doubt by quoting the following clause from the Company's Act: "The Company of proprietors shall from henceforth be fully authorized and empowered to make or cause to be made or manufactured gas or inflammable air from coal as well as from oil and from any other material, liquid, or substance whatsoever, and to contract for and sell and dispose of the same," &c.

Surgeon Lieut.-Col. Cayzer never misses an opportunity of showing his antagonism to the supply of carburetted water gas. After the previous agitation at Garston had died out, he looked about for fresh fields of operation, and found some; but no one seems to have paid much heed to his writings. He has now returned to the charge at Liverpool, and generously gives to the citizens his latest information on the subject. He says: "The public may rest assured that in no case is carburetted water gas supplied unmixed to any portion of the city of Liverpool. That gas will never again be supplied unmixed with coal gas to any place in the United Kingdom. The disastrous results in Garston and America forbid such a possibility. Since Jan. 27, 1897, carburetted water gas has never been supplied in larger proportion than 50 per cent. mixed with 50 per cent. of coal gas. The proportion of the poisonous gas—viz., carbon monoxide—has been about 7 per cent. in the coal gas alone; and with the 50 per cent. of carburetted water gas added, the proportion of poison has been about 20 per cent. in the mixture supplied. This is, in my opinion,

a very dangerous proportion. In Glasgow, with its large population, the gas is enriched with materials which add not one fraction of carbon monoxide to the originally dangerous quality of coal gas. The carburetted water gas had a fair trial there, and was given up by Mr. W. Foulis, the Gas Engineer, as too costly in comparison with his own scheme, which Dundee is about to adopt for economical reasons. In a letter to me, dated Feb. 22 of this year, Mr. Foulis says: 'We do not now make carburetted water gas, as we find it more economical for enrichment purposes to make undiluted oil gas; and, so of course, we have no trouble with carbon monoxide.' . . . Last year I wrote that the deaths in Massachusetts from carburetted water gas and its mixtures numbered 51 during 1896. During 1897 the deaths reached in that one State the number of 60, besides injuries to 74 persons. In England we have had already this year one death and injury to ten other persons." In a subsequent letter, Surgeon Lieut.-Col. Cayzer states that the carbon monoxide in the gas supplied in Garston in the early part of the afternoon of the 5th inst. amounted to 23 per cent., and that it rose to 23·2 per cent. within two hours.

THE REMOVAL OF DISUSED GAS-MAINS.

The question as to the responsibility or otherwise of London Gas Companies to remove disused gas-mains on laying new pipes has reached an acute stage in St. Pancras, and will probably be brought before the Board of Trade at an early date. In this connection, it may be mentioned that the Highways Committee presented the following report on the subject at a recent meeting of the Vestry: "The attention of your Committee has been drawn by the Engineer and Surveyor to the objectionable practice of The Gaslight and Coke Company, when laying new mains in the parish, of leaving the old disused mains in the ground, and that the Engineer to the Gas Company has declined to remove such old disused mains when requested to do so, and has given notice of intention to lay a 4-inch main under the footway in College Place, instead of in the line of the old main under the roadway. In the 109th section of the Metropolis Local Management Act, 1855, it is provided that 'no gaslight company shall at any time break up or open any pavement or surface of soil for the purpose of laying down any new mains or pipes without the consent in writing of the Vestry or District Board;' but the Metropolis Gas Act, 1860, gives power to the Secretary of State to authorize gas mains and pipes to be laid down by Companies in accordance with the provisions of that Act, where the Local Authority refuse or delay their consent. In the case under present consideration, no absolute refusal has been made by the Engineer and Surveyor, acting on behalf of the Vestry, but in fact he has given a conditional consent—the condition being that the main shall be laid in the course of the old trench, in order to ensure the taking up of the old main; and the Company's officials refuse to take up old mains when laying new ones in a different part of the street. The Gas Company have given notice of their intention to appeal to the Board of Trade if the Vestry persist in the attitude adopted in the matter. Irrespective of the expediency of requiring the removal of old mains, there are tangible objections to be raised in some cases against the use of the footways for gas-mains. The principal, from the Vestry's point of view, is that, as the Electric Lighting Authority, it is highly desirable they should reserve the footways for the use of the Electricity Department, for supplying the public as well as the public lamps; and it may also be considered desirable to protect the inhabitants from a possible source of danger by the too close proximity of gas-mains to dwelling-houses, if the mains were laid under the footways." The Vestry, without any discussion, approved the action of the Engineer, and decided to inform the Gas Company that the Vestry would be prepared to contest the matter before the Board of Trade should the threatened appeal be proceeded with.

SWANSEA GAS COMPANY.

Annual Meeting—The Corporation and the Company's Bill.

The Annual Meeting of this Company was held on Thursday last—Mr. TRAVERS WOOD in the chair.

The notice convening the meeting having been read,

The CHAIRMAN moved the adoption of the report and accounts. In a speech of considerable length, he first referred to the successful working of the Company during the past six months, notwithstanding the very mild season and the depressed state of the tin-plate trade. This had considerably affected the gas-rental; but notwithstanding there was an increase of 2¼ per cent. as compared with the corresponding period of 1896. The residual products showed a decrease of £470 arising from the smaller quantity of coal carbonized, which, of course, tended to the credit of the manufacturing department. The make of gas for the half year showed a considerable increase per ton of coal carbonized, owing to the satisfactory working in the retort-houses. Alluding to the Company's Bill, he said it came before a Select Committee of the House of Lords on March 21, and was opposed by the Corporation, who lodged a petition in the House on the last day for doing so. The Corporation attacked the Company on twelve points; but completely failed to impose conditions which Parliament have never granted before. By the wild and extravagant assertions contained in the petition, the Committee evidently saw that it was unfounded and groundless. On the four chief points of contention, the Chairman of the Committee of the House of Lords stated: "The Committee are unanimous in giving it against the Corporation on all four points. The Bill may proceed." The Bill had been read a third time, and passed the House of Lords on March 29, and had already passed the second reading in the Commons. The Company had secured all they desired; and their rights and privileges had in no way been infringed. The price of gas, quality, and illuminating power, testing-places, capital, dividends, and reserve fund remained intact, and the value of their property was in no way diminished. It was hoped that the Company were now secure for a great many years from such vicious attacks from the Corporation as in the past. It was a great loss to the consumers that the sliding-scale clause had been withdrawn, as it provided that for every ¼ per cent. increase in the dividends, the consumers would have obtained a benefit of 4d. The Corporation in 1888, when the Company went to Parliament, wanted this clause inserted; but the Company then declined it. Now when the Company wished to insert it as a sop to the Corporation, the latter declined it. (Laughter.) The Directors congratulated the shareholders and ratepayers alike on the result of the injunction applied for by the Company against the Corporation for not complying with the Borough Funds Act of 1872 in first consulting the ratepayers as to their desires to oppose or promote a Bill in Parliament. Such consent was never asked or obtained; and the Company, in view of the interests of the shareholders and ratepayers, thought it prudent to accept the advice of their Parliamentary Agent, and apply for an injunction to restrain the Corporation from using the borough funds, or rates, for the purpose of opposing the Bill in Parliament, without first obtaining the consent of the ratepayers. The result of the injunction now remained to be seen, and the effect on the Corporation. It was an important decision, affecting the interests of the whole of the corporations in the kingdom; and the Company were quite prepared for any further contest in the matter. Up to the present time, the interests of the ratepayers had been ignored by the Corporation; and the Company trusted that a salutary lesson had been taught the Corporation over their duties to the ratepayers. As soon as the Bill became law, the prepayment meter system would be introduced.

The report was adopted; the usual dividends at the rates of 10, 7½, and 7 per cent. were declared, the retiring Directors and Auditor were re-elected; and the remuneration of the Board was increased to £800 per annum.

A complimentary vote was passed to the Directors for their energetic efforts during the last few years in upholding the rights of the Company; and Mr. Thornton Andrews (the Engineer and Secretary) was specially thanked for the skill and ability that he had displayed in the conduct of the Bill and other matters during the past session.

INCANDESCENT GAS LIGHTING AT LEWES.

At the Meeting of the Lewes Town Council on the 6th inst., the minutes presented by the Highways and Works Committee contained a paragraph stating that a letter had been received from the Manager of the Gas Company (Mr. Levi Monk) in reference to the incandescent gas-lights in the town, and it had been resolved to direct the Town Clerk to write and thank the Company for the experiments they had made at their own cost, with a view to improving the public lighting of the town, and at the same time to inform the Company that the Committee, did not consider the experiments had been altogether satisfactory, as the system did not appear to be suitable for street lighting. The Committee would therefore be glad if the Company would replace the old burners. The Chairman of the Committee (Mr. Barrett) said he did not think the recommendation reflected the true opinion of the Committee. Since the resolution was passed, a communication had been received from the Company's Manager, and he (the speaker) felt persuaded that if the letter had been received in time for consideration by the Committee, they would not have agreed to such a resolution as appeared on the *agenda*. The Manager said the Company were willing to continue the lights, numbering 106, and would not charge anything extra for them—either for the first cost or their maintenance during the current quarter. He (Mr. Barrett) thought it was fair and reasonable that the Council should accept the offer. Why should they do away with so excellent a light, when no expense would be incurred by the Corporation? Mr. Savage characterized the action of the Chairman of the Committee as a change of front. He said they had had a letter from the Manager of the gas-works under notice for three months; and he thought the charges for the burners and mantles almost frightened the Committee. They considered the charges a gross imposition; and, moreover, the light was not so good as they expected. Alderman Hillman said he had no doubt Mr. Savage was under the impression that the town was put to great expense in consequence of these important alterations. He (the speaker) believed the Company were willing to pay for the extra fittings; and he thought they would find that the cost for gas during last quarter was not in excess of the charge for the corresponding period of 1897. Why should they go back to the old miserable burners when they could continue a beautiful light which had given satisfaction to every person in the town? Bearing in mind that the Company had fitted 106 lamps with incandescent burners, with no expense to the Corporation, and were willing to keep them in order, he thought it was monstrous they should be treated in this way; and he made no hesitation in saying so. He moved, as an amendment, that the paragraph in question be struck out. The Mayor (Mr. Gates) pointed out that anyone interested in the Company could speak, but not vote; and he ruled that moving an amendment amounted to the same thing as voting. Mr. Hillman thereupon moved the amendment, and it was seconded by Mr. Riekie. Mr. Savage said he should oppose the amendment. It seemed to him that the Company had seen the error of their ways, and had written the letter as a result. From what he understood, the previous Chairman of the Committee gave permission for 17 burners to be fixed; but the Company had taken upon themselves to put up 130. Mr. Hammond expressed the opinion that there was no ground for the strong remarks which had been used in reference to the Company. He thought their only desire was to give the town as good a light as they possibly could. Alderman Hillman added: "And at the smallest possible cost." Mr. Barrett said he gave the Manager of the Company permission to put up the extra burners. There were now 106 lamps fitted with them, out of a total of 235. The amendment was carried; and the report, with the paragraph omitted, was adopted.

Dunstable Gas and Water Company.—The 26th annual meeting of this Company was held last Tuesday—Mr. B. Bennett presiding. The report showed a profit of £1361 from the gas undertaking, and a balance of £1508 on the water undertaking; dividends of 8 and 7½ per cent. respectively being recommended, with 4 per cent. on the "B" gas shares. The Chairman said the report was more satisfactory than it had been for some time; there being an increase on the gas account (which had been stationary for three years) owing to the introduction of slot meters, 50 of which were now in use. The water revenue had not increased; but when the Corporation decided on a drainage scheme, the receipts would advance rapidly. The report was adopted.

SUPPLY OF WATER GAS AND COAL GAS IN BOSTON (MASS.).

In the "JOURNAL" last week, we published the concluding portion of a special report made by the Board of Gas and Electric Light Commissioners of Massachusetts to the State Legislature, relative to certain deaths from asphyxiation by illuminating gas which occurred at Boston in January last year. The Commissioners were also ordered to report generally on the subject of the supply of water gas and coal gas in the city. Four questions were submitted on which the Legislature required information; and a definite answer was requested to an additional one. The questions were as follows:—

1.—The present manufacturing capacity of the several coal-gas plants which distribute coal gas in Boston; the quantity of coal gas distributed in 1896; the parts of Boston in which coal gas was distributed; the companies which supplied coal gas; the value of the coal-gas plants of the several companies; the approximate number of consumers of coal gas; the price or prices of coal gas distributed; the number of accidental deaths due to the inhalation of coal gas; the number of accidents, other than fatal, reported to the Board, due to the inhalation of coal gas.

2.—The present manufacturing capacity of the several water-gas plants which distribute water gas in Boston; the quantity of water gas distributed in 1896; the parts of Boston in which water gas was distributed; the companies which supplied water gas; the value of the water-gas plants of the several companies; the approximate number of consumers of water gas; the price or prices of water gas distributed; the number of accidental deaths due to the inhalation of water gas; the number of accidents, other than fatal, reported to the Board, due to the inhalation of water gas.

Also, upon the same matters in regard to mixed coal and water gas plants, and mixed coal and water gas.

3.—The best method of using existing mains now unused, if any, and mains now used for the distribution of water gas, particularly in portions of the city where tenement houses and lodging-houses are most numerous, for the distribution of coal gas manufactured in existing coal-gas plants; the approximate expense of the necessary connections and cut-offs and other work required to use such mains for the distribution of coal gas; the smallest amount of water gas necessary to supply the city of Boston if the existing coal-gas plants are operated to their full capacity.

4.—The opinion of the Board as to which of the methods outlined in the report of the minority of the Committee on Manufactures, under the head of "Recommendations," is the more feasible, and will result in greater protection to human life.

5.—Whether the substitution of a mixed gas, containing not over 16 per cent. of carbonic oxide, in place of water gas, may reasonably be expected to result in a considerable diminution of fatalities by gas in Boston.

As already mentioned in the "JOURNAL" (*ante*, p. 703), two reports were presented on the matters embodied in the preceding questions. The following is the majority report, which is signed by Messrs. Forrest E. Barker and Chas. H. Gifford:—

The replies to the inquiries in paragraphs 1 and 2 are shown in the accompanying table.

Name of Company.	Daily Capacity.		Sales in Boston in 1896.			District Supplied.	Value of Plants.		No. of Consumers.		Price Net.	No. of Deaths.		Non-Fatal Accidents.
	Coal Gas.	Water Gas.	Coal Gas.	Water Gas.	Mixed Gas.		Coal Gas.	Water Gas.	June 30, 1896.	Dec. 31, 1896.		Accidental.	Suicidal.	
	Cub. Ft.	Cub. Ft.	Cub. Ft.	Cub. Ft.	Cub. Ft.									
Bay State .	—	10,500,000	..	2,955,800	..	Boston . . .	..	$650,000	23	23	$1 00	..	1	..
Boston . .	2,800,000	4,350,000	..	591,314,149	542,020,022	Boston — old city. . . .	$150,000	300,000	29,787	29,608	1 00	20	3	13
Brookline .	..	4,000,000	..	656,207,392	..	Brighton and Roxbury districts*. . .	..	275,000	26,667	21,274	1 00	7	9	4
Charlestown	500,000	300,000	..	..	78,751,200	Charlestown .	24,000	13,000	3,144	3,414	1 25	1	..	1
Dorchester .	300,000	..	..	173,277,100	..	Dorchester .	17,000	..	6,714	7,438	1 00	2	..	..
East Boston .	400,000	..	47,105,349	..	..	East Boston .	20,000	..	2,217	2,342	1 50	..	..	..
Jamaica Plain	500,000	..	64,851,948	..	..	Roslindale and West Roxbury†. . .	23,000	..	2,636	2,890	1 40	..	..	..
Roxbury . .	500,000	..	..	219,904,139	..	Roxbury . .	23 000	..	10,103	10,065	1 00	2	1	1
South Boston	425,000	..	..	109,733,404	..	South Boston.	21,000	..	4,368	4,535	1 00	..	..	3

* In Boston proper, southerly and westerly of a line through Friend, Hanover, Beacon, Charles, Boylston, West, and Essex Streets; in Dorchester, between Norfolk Avenue and Quincy Street; and in South Boston, on Broadway.

† Also Jamaica Plain, as far down town as Perkins, Paul Gore, School, and Beethoven Streets.

The quantity given as the sales of the Bay State Company is the amount sold to private consumers. Nearly all of the gas made by this Company was sold to the Boston, Dorchester, Roxbury, and South Boston Companies; and the total sales for all purposes were 1,084,312,100 cubic feet. The capacity of the Bay State works given in the table is the generating capacity of the plant. As the capacity of the other portions of the plant does not exceed 5,000,000 cubic feet, only that portion of the generating plant can be used at one and the same time.

The mixed gas sold by the Boston Companies contained about 84 per cent. of carburetted water gas and 16 per cent. of coal gas, and was made between Jan. 1 and June 5. Of the 23 fatalities given in the table as occurring from the Boston Company's gas, 14 were in wards 6, 7, and 8. Of these, three happened before and eleven after June 5. Of the non-fatal accidents in the same district from the gas of this Company, three happened before and five after that date.

The figures given to show the value of the plants are estimates rather than the result of detailed appraisals, but are believed to be fairly correct. They are designed to show the value only of those portions of the entire plant which are peculiarly and exclusively for the kind of gas named, and do not include those parts which are adapted to both kinds of gas.

The third, fourth, and fifth divisions of the order are so intimately related that they can best be considered together. As we understand the inquiries, they relate to the comparative feasibility of supplying a certain district of the city of Boston with coal gas exclusively, and of supplying the entire city with a mixed coal and water gas containing not more than 16 per cent. of carbonic oxide, and what effect the adoption of either of these methods might be expected to have upon the death-rate. It should be observed at the outset that this inquiry involves the consideration of a somewhat difficult and complex problem in gas engineering, which the time available under the order will not allow the Board to exhaustively examine; and we are able, therefore, to present only those general facts which seem to us important, and in which we have confidence.

We are asked to give information upon the best method of using existing mains now unused, if any, and mains now used for the distribution of water gas in portions of the city where tenement houses and lodging-houses are most numerous for the distribution of coal gas manufactured in existing coal-gas plants, with the approximate expense of such arrangement. It should be noted first that, according to our information, the Boston and Brookline Companies have no unused mains which are suitable for use.

If we divide the fatalities during the year 1896 according to the sections of the city in which they occurred, we shall find that about 51 per cent. were located within wards 6, 7, and 8 of Boston, and that the others were distributed quite generally over the remaining parts of Boston in which the gas made by the Boston, Bay State, and Brookline Companies was sold. This district also seems to correspond as closely as any to that described in the order as "where tenement houses and lodging-houses are most numerous."

It happens also that within this district are the old works of the Boston Gaslight Company, known as the North End station, now equipped for the manufacture of both coal and water gas. From these works lead three or four large mains, which pass through this district, and are used partly to supply the same and partly to convey gas for distribution in other parts of the city. It is more than probable that two of these mains might be ample to supply this district; and, as the entire distributing system of the Boston Company is known to be equipped with valves to a degree perhaps unequalled by any other company, it is not unfair to assume that this section can be cut off from the remaining portions of the city without large expense, and that the trunk lines not used for its supply may also be so far isolated that they could readily be used for the conveyance of some other kind of gas to other sections. So far, then, as the distributing system is concerned, there would seem to be no serious difficulty in the plan proposed in the order for supplying this district with coal gas.

If this district is to be supplied from existing coal-gas plants, the gas must be made at either the North End or the Commercial Point station. The North End station has a manufacturing capacity of 1,300,000 cubic feet of coal gas per diem. The maximum consumption in the area named would probably be about 1,500,000 cubic feet. If the supply were to come from this station, it would therefore be necessary to increase the capacity of this plant by the erection of additional benches and a retort-house with a capacity of about 200,000 cubic feet per day. It would also be necessary to erect two holders with a capacity of about 1,000,000 feet each, and to purchase land for this purpose, as the Company have no land in that section available for this use. Land in this part of the city is very expensive; and the necessary land, holders, and other machinery would probably call for an expenditure of from $700,000 to $900,000, according to the cost of the land.

The holders now at this station have a working capacity of about 500,000 cubic feet only, and would be needed in connection with the water-gas plant which it seems necessary to continue to operate for the supply of other sections, unless large expenditure is to be made elsewhere. Further expenditure would also be needed for the replacing of that apparatus which might be devoted exclusively to coal-gas making, if it became necessary to continue the manufacture of water gas at this station.

The Commercial Point works have a daily capacity of from 1,500,000 to 2,000,000 cubic feet of coal gas, which would be ample to supply the district under consideration. The holders at this station are in use, and seem indispensable for the general distribution of gas throughout the city. It would therefore be necessary to erect here two new holders similar to those above described, and to construct a new trunk line main from these works to the North End—a distance of about six miles. The cost of the necessary work for this purpose would probably not exceed $450,000 or $500,000.

If this expenditure were made and the plan inquired of carried out, we should then have two sections of the city separated only by a single street or at most a single block, one supplied with a gas of about 24 or 25

candle power, and the other portion supplied with about 18-candle power, with no reasonable expectation of a reduction in price on that account. From this point of view, the feasibility of the plan may well be doubted. There can be no reasonable doubt, however, that, if such gas were distributed in this area, the number of fatalities there occurring would be greatly reduced.

The other proposition which we are asked to consider is the feasibility of supplying a mixed gas with not more than 15 or 16 per cent. of carbonic oxide. This requirement calls for a mixture containing about 40 per cent. of water gas and 60 per cent. of coal gas. As the maximum daily output of the Bay State and Boston Companies has already exceeded 8 million cubic feet, it would be necessary to have a coal-gas plant of at least 5 million cubic feet capacity, or an increase of about 2 million cubic feet per day. The nominal capacity of the coal-gas works of the Dorchester, Roxbury, and South Boston Companies is 1,225,000 cubic feet; but the works at Dorchester have been unused since July, 1889, those at Roxbury since May, 1890, and those at South Boston since May, 1894. None of these works are now large enough to supply their districts. All combined would be unable to supply the amount needed; they would probably require extensive repairs to fit them for economical operation, and their distances from each other and from the water-gas plants are so great that it would probably be more economical to erect an entirely new works at a single point than to undertake to repair and operate the three plants named.

It would probably be advisable to enlarge the plant at Commercial Point to make the additional quantity necessary for the plan suggested. Coal gas could then be made at this station, and water gas at the Bay State works, and the product of the two taken by large mains to some convenient third point, where they could be properly mixed and made ready for distribution. At the point of meeting of the gases, it would be necessary to construct a number of large holders, which, either alone or in combination with other holders, would contain an entire day's output, or about 8 million cubic feet. The main already built from the Bay State works might be used under this arrangement; but it would probably be necessary to build a new main from the Commercial Point works, a distance of from one to three miles, according to the location of the mixing station.

This construction would probably cost from $800,000 to $1,000,000; increasing by this amount the capital of the Bay State and Boston Companies. This expenditure makes provision for the present consumption of the group of Boston and Bay State Companies, and does not include the Brookline. This Company has an extensive system of mains in Boston proper and the Roxbury and Brighton districts; also to some extent in Dorchester and South Boston. It makes water gas at its Allston station, and has no coal-gas plant. It has a capacity of about 4 million, and a maximum output of a little more than 3 million cubic feet. To supply a mixed gas with not more than 16 per cent. of carbonic oxide would require the construction of a complete coal-gas plant with a capacity of about 2 million cubic feet. It has about 1½ acres of land in Brookline not used for gas making; but this would be too small for a plant of this capacity. Whether contiguous land could be obtained for this purpose would certainly be doubtful. Assuming that the Company could secure a suitable location for such a works within its territory, it would be necessary to connect the two stations with large lines of mains. So much would depend upon the location of such new station and the amount of connecting main, that it is difficult to express an opinion as to the cost of such construction; but it could hardly be less than $1,000,000 in any event.

To provide for the supply of a mixed gas with no more than 16 per cent. of carbonic oxide throughout the city of Boston would probably require, therefore, an addition to the present capital of the Bay State, Boston, and Brookline Companies of about $2,000,000, or about 20 per cent. The inevitable increase of fixed charges resulting from this may reasonably be expected to have its effect upon the price of gas. The candle power would probably be reduced from 25 to about 20. Viewed solely as a business proposition, this plan seems to be feasible, provided the public is willing to bear the additional capital charge, and to use a lower candle power gas.

A reliable answer to the question of whether the substitution of a mixed gas containing not over 16 per cent. of carbonic oxide would largely reduce the number of fatalities, must depend in great measure upon data which the Board does not possess and has been unable to obtain. As between 26 and 6 or 8 per cent., there seems to be a consensus of scientific opinion that a change from the former to the latter would greatly diminish the number of fatalities. As to the effect of a change from 26 to 16 per cent. there is not the same agreement. Reasoning from the fact that there is less of the poisonous ingredient, it would be reasonable to expect that the gas would be less dangerous, and that it would cause fewer fatalities. But if, on the other hand, the length of time during which persons in these accidents are usually exposed to the effects of the gas is a sufficient time to produce death from gas with 16 per cent. of carbonic oxide, then such percentage could not be expected to greatly reduce the number of fatal cases. It might allow the resuscitation of those persons who, as sometimes happens, are alive when found after being subjected to gas with 26 per cent., but are not restored to consciousness. It is doubtful if the lower percentage named would result in any considerable diminution of the number of fatalities. Experience only can satisfactorily answer this inquiry.

If the existing coal-gas plants of the Boston, Dorchester, Roxbury, and South Boston Companies were operated to their fullest capacity, it would be necessary at the time of greatest consumption to make about 4 or 5 million cubic feet of water gas per day. If the plants of the Boston Company only were thus operated, the amount of water gas necessary would be about 5 or 6 million cubic feet per day. This amount would, of course, vary, and decrease with change of output and change of season.

The minority report, signed by Mr. Morris Schaff, is as follows:—

I concur with the majority of the Board in its answers to points Nos. 1, 2, 3, and 4; but I find myself unable to agree with its answer to point No. 5, for these reasons: (1) I do not share my colleagues' doubts that a reduction of the present amount of carbonic oxide from 26 and 27 per cent. down to 16 per cent. would make any considerable reduction in the death-rate. I think it would make a very considerable reduction. (2) The reply is too indefinite, and suggests no remedy.

The gravity of the issue raised by the investigation under which the opinion of the Board is asked for information upon matters of fact and for an expression of opinion, involving, as it does, reasonable safeguards for human life and the security of heavy investments in the property devoted to the manufacture of water gas, imposes upon the Board the duty of going further than a perfunctory answer to point No. 5, and calls upon it to outline, as well as it may, a remedial policy that, in its judgment, will tend to secure both life and property.

For reasons already set forth, it seems clearly inadvisable to compel the companies to make at once a mixed gas containing not over 16 per cent. of carbonic oxide. But it does seem wise to inaugurate such a policy as will set them on the road to reach that proportion, or one of more or less than that percentage which experience may show to be the limit of reasonable safety. To this end, and for their own welfare, since their interest cannot lie in the increasing death-rate, the companies themselves should co-operate. Let them, therefore, begin by again putting their North End and Commercial Point coal-gas works in full operation. It would effect a material reduction of from 25 to 30 per cent. in the present amount of carbonic oxide in the gas supplied through the territory where the mortality was greatest; and with every reduction there is reason to believe there should be a diminution in the death-rate. When and how this policy should be inaugurated, should be left to the discretion of the Board; but it should be made obligatory.

ELECTRIC LIGHTING NOTES.

The Yarmouth Town Council have decided to borrow £4800 for further additions to their electric lighting plant—making in all £40,000 borrowed for that purpose.

The Carlisle City Council have received the formal sanction of the Local Government Board to the borrowing of £30,000 for the purposes of electric lighting, and the Bootle Town Council to the borrowing of £33,594 for the same purpose.

The Sheffield City Council last Wednesday approved of an application being made to Parliament in the present session for a Local Act, to confirm an agreement for the purchase of the undertaking of the Sheffield Electric Light and Power Company's property.

The Sunderland Town Council last Wednesday adopted a report of the Lighting Committee, advising an application to the Local Government Board for their sanction to the borrowing of £26,000 for extending the electric lighting plant. It appears that the demand for current has grown so much of late that it has become imperative to have the generating station enlarged. Requests for the light continue to be received from all parts of the town; and it is intended to increase the number of street-lamps.

The Electric Lighting Committee of the Croydon County Council have formally taken over the electric lighting supply from the Company who erected and carried on the works until March 25 last. Considerable extensions are already contemplated. Application is to be made to the Local Government Board for sanction to a further loan of £3000 for additional buildings and other work at the station; and, more important still, the Committee have decided, and their decision has been adopted by the Council, to extend the supply of current to the South and Upper Norwood districts. Upon this subject, and the making of necessary additions to the present plant, the advice of Professor Kennedy has been sought. In his report, he suggests an expenditure of rather more than £17,000; and consequently it has been resolved to ask for the consent of the Local Government Board to the borrowing of the sum of £26,000. Notice is also to be given to the Crystal Palace District Electric Supply Company, under the provisions of their Orders of 1890 and 1894, requiring them to sell to the Corporation so much of their undertaking as is within the borough, subject to all existing rights and contracts, at a price equivalent to the capital expenditure properly incurred upon the portion of the undertaking, with an addition of 33 per cent.

The Manchester City Council will to-morrow consider a recommendation of the Electricity Committee that application be made to the Local Government Board for their sanction to the borrowing of £150,000 for the purposes of the electricity undertaking. The Electrical Engineer (Mr. Wordingham) has prepared a report in which he deals with the conditions of the problem which have now to be solved. The city area is some 20 square miles. In addition to the supply of this area, arrangements have been entered into with the District Councils of Moss Side and Levenshulme; and it is practically certain that a similar agreement will be made with Withington, while there is still a possibility that a supply will also be required by Stretford. Other District Councils are considering as to whether they shall take the supply from Manchester—notably Denton, Audenshaw, Failsworth, Gorton, and Heaton Norris; and even Sale is about to discuss the matter. "It is thus possible," Mr. Wordingham says, "that we may be called upon to supply a total area of some 40 square miles." As the crow flies, some points will be 8 miles distant from a proposed new generating station; and Mr. Wordingham does not think that the supply can be given economically if a lower pressure than 5000 volts be employed, though it might possibly be desirable to go higher—say, to 10,000 volts. He prefers, however, to use as low a pressure as is consistent with efficiency.

The Marsden District Council and their Gas Manager.—An appreciative reference to the services of the retiring Gas Manager (Mr. F. Lee) was made at the last meeting of the Marsden District Council by the Chairman of the Gas Committee (Mr. A. Robinson). He said he wished to take that opportunity of expressing their regret that Mr. Lee had resigned his post as Gas Manager. The only consolation was that their loss would be Hinckley's gain—Mr. Lee having been appointed Manager of the gas-works there. During the time he had been in charge of their works, many improvements had been made. More gas was now manufactured per ton of coal, by which a saving of £200 a year was effected. Mr. Lee had also reduced the leakage from 16 to 12 per cent., which meant a saving of £50 a year. They had some reason to regret his departure from among them. The Chairman of the Council (Mr. S. Firth) also felt that Mr. Lee's term of four years had been so successful that he could not let him depart without some acknowledgment. Mr. Lee now left the gas-works in thorough working order; and he (the Chairman) wished him well in his new sphere.

SEARCHING FOR WATER WITH THE DIVINING-ROD.

A Diviner's Fees Surcharged.

Several ratepayers attended the audit of the accounts of the Ampthill Urban District Council last Wednesday, and objected to a payment to Mr. Leicester Gataker for divining for water. It was stated that on a similar objection last year the Auditor had surcharged the fees paid to the diviner, and an appeal had been made to the Local Government Board, but had not yet been decided. Mr. Gataker had one divination in which he recommended borings in a place called Fountaine's Field, near the surface, and in the greensand. After some boring had been undertaken, and a water engineer had recommended the abandonment of the work, Mr. Gataker had furnished a further divination, locating ten fresh so-called springs. These, it was objected, were contrary to the first series of divinations in the same field, as at the depths indicated it was affirmed by geologists that there could be no water at all, for the borings would then be deep in the Oxford clay. Mr. W. A. Casson, the Local Government Board Auditor, in giving his decision, quoted Professor Barrett, who had written a monograph "On the So-called Divining-Rod," which was published in the "Proceedings" of the Society for Psychical Research.* Though apparently strongly biassed in favour of diviners, Professor Barrett admitted that their general ideas of water were absurd, as they imagined springs to exist like buried treasure, located to an area of a few square inches, or as underground rivers which they professed to trace within an inch on either side. Mr. Casson stated that he could not, in the interest of the ratepayers, do other than surcharge the members with the fees objected to, as he was of opinion that Mr. Gataker had, with a view of obtaining the fee paid to him by the Council, made pretence to a power within the meaning of the decision in the case of *Regina v. Maria Giles* (34 L.J., M.C., 54), in which it was held that "the pretence of a power, either physical, moral, or supernatural, and obtaining money by the false assertion of such a power, whatever it may be, is an indictable offence under the letter of the statute, and within the mischief intended to be prevented by it." The consideration in the agreement for Mr. Gataker's employment was therefore an illegal one, and the agreement for such employment void in law. He regarded divination as a survival from times when magic and witchcraft were generally believed in, and when the divining-rod was used to discover not only sources of water but lodes of metal ore, hidden treasure, the bodies of murdered persons, and lost boundaries of land. Where the practice of divination was not deliberately fraudulent, it was perhaps explicable on the hypothesis of self-deception; and the fact that where scientific tests were applied to diviners the experiments generally failed, showed that much depended on what an eminent geologist who had written to him described as the use of an eye trained to notice the surface features of the ground.

THE TREATMENT OF FACTORY SEWAGE AND REFUSE.

At the Meeting of the London Section of the Society of Chemical Industry on Monday, the 4th inst., a paper by Mr. W. J. Dibdin, on "The Bacterial Treatment of Sewage containing Manufacturing Refuse," was read by Dr. G. Thudichum in the absence of the author, who was unfortunately suffering from the effects of a recent attack of influenza.

The paper dealt with the application of the bacterial method of purifying sewage, to sewage containing a more than usual proportion of manufacturing refuse. The bacterial method has been used successfully at Sutton, and other places where the character of the town sewage is not affected by the refuse from special local industries; but doubt has been expressed in many quarters as to the efficacy of the method when applied to the sewage of manufacturing towns. The aim of the paper was to give the results of experiments made on the bacterial treatment of the sewage of such towns, in order to dispel the doubt as to the general utility of the method. In the first place, the author insisted on the fact that London sewage contained a large proportion of manufacturing refuse, and that he had already shown, in a paper read before the Society in November, 1895, that London sewage was amenable to bacterial treatment. The refuse in London sewage was, however, very mixed in character, since it was derived from an immense variety of industrial operations. It was deemed desirable to experiment with sewage in which the refuse from one or two industries predominated.

At Leeds, the sewage contains a large amount of manufacturing refuse, derived chiefly from tanneries, galvanizing and copper works, and breweries. The results of dealing with 200,000 gallons of Leeds sewage per diem by the method were very satisfactory. When the filtration beds were used thrice daily, the amount of oxygen absorbed by the filtrate from the first bed (coarse breeze) was 1·31 grains per gallon; and from the second bed (fine breeze), 0·53 grain per gallon. The untreated effluent had been proved previously to give an oxygen absorption of 3·91 grains per gallon. Experiments were carried out on a laboratory scale with Maidstone sewage, which contains a large amount of refuse from tanneries and breweries; and equally satisfactory results were obtained. At West Bromwich, the sewage is very much contaminated with the refuse from galvanizing works; but the bacterial treatment answered well. The iron in the sewage of West Bromwich and Wolverhampton renders chemical treatment necessary before the filtrate can be turned on to land; and Mr. Dibdin considered that this treatment was better carried out on the effluent before it was subjected to the action of the filter-beds. At Yeovil, the sewage receives the refuse from leather dressing, and contains arsenic. Nevertheless the bacterial method of treatment could be successfully applied to Yeovil sewage. The method had been tried on sewage in which the refuse from nearly every important industry was found; and whatever the nature of the refuse which predominated, the treatment was perfectly satisfactory. In one case only had any difficulty been experienced. The refuse from gas-works liquor prevented the bacterial treatment of sewage until the latter was considerably diluted. After dilution, sewage contaminated with gas-works refuse could be put on the filter-beds with perfectly good results.

The paper was discussed by a large number of members of the Society and interested visitors. Mr. Wood Smith questioned if the bacterial treatment disposed of pathogenic organisms, and suggested that it ought to be followed by treatment with chlorine or other sterilizing agent. This proposal was ridiculed by Dr. Dupré and many other speakers. Dr. Dupré said that it was a well-known fact that typhoid bacilli lived for a very brief period in town sewage, and that few could escape the filter-beds. He hoped that the Royal Commission which would shortly be asked to inquire, on behalf of the Board of Trade, into methods of treating sewage would appoint Sir E. Frankland as their chemical adviser. He considered that manufacturing refuse which could not be dealt with on a sewage farm could be treated by the bacterial method. Dr. S. Rideal thought it had been shown that any refuse which did not actually sterilize the sewage could be successfully dealt with by Mr. Dibdin's process. Mr. H. A. Martin had supervised trials of the method at Exeter, and spoke very favourably of it. Dr. Clowes thought it remarkable that oxidation of ferrous to ferric salts in sewage had been attributed to the agency of the bacteria, and wondered if this oxidation was not due merely to the aerating action of the filter. Mr. Fletcher and Mr. E. G. Hooper spoke of the disappearance of sludge in cesspools which had been in use for years, and drew analogies between the action which occurs in them and in the septic tank. Mr. Pakes pointed out that the bacterial treatment of sewage was a development of the nitrification process, which went on in soil through the agency of nitrifying organisms, and was quite distinct from the septic-tank method of dealing with sewage.

In his reply to the questions asked in the discussion by the above and many other speakers, Dr. Thudichum stated that the bacteria of typhoid had no chance of surviving the treatment of the bacterial process, as they had been found to be no longer alive in a main sewer at a distance of only 50 yards from the point where the sewage from a fever hospital entered. The amount of solid matter screened off in the process was quite trifling; and the rest of the suspended solids were completely peptonized and taken into solution. Therefore, strictly speaking, the method yielded no sludge.

* See "JOURNAL," Vol. LXX., p. 1165; also *ante*, p. 175.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

Two of the four public meetings of gas managers which are held annually in Scotland have now taken place this year—the "Informal" meeting in Glasgow, and the equally informal spring meeting of the regularly constituted Waverley Association in Edinburgh. I wish to record my opinion that if the two meetings which have yet to be held—the North British Association meeting in Glasgow at the end of July, and the autumn meeting of the Waverley Association at Duns in September—be anything of the same quality as those which have taken place, there will be a general elevation of the whole field within which these gatherings operate. I cannot explain why it should be, but I have never returned from any meetings of gas managers with greater feelings of regard than I have from these two. It is impossible for me to draw a distinction between them. This is the first year in which there has been reciprocity among the parties who convene these meetings. I do not mean that animosities have been set aside, for there were none, and indeed could not be, because the whole of the bodies were interchangeable, in the matter of membership; but this is the first year in which all three have been officially represented. At the "Informal" meeting last week, the North British Association and the Waverley Association were represented; and at the meeting of the Waverley Association this week, the North British Association and the "Informal" meeting, in the person of the Convener thereof—Mr. A. Yuill, of Alloa—were both represented. It was the standardizing of meter unions which formed the principal subject of consideration at the Waverley meeting. I trust the effect of this year's meetings will be the fixing of an indissoluble union, in the matter of harmonious working, between all who seek to promote comradeship among the gas managers of Scotland. A good beginning has been made. If the meeting in Glasgow was a success, that of the Waverley Association was still more so; for in it the Association leaped all at once from being an assemblage of a handful of small managers, into a large meeting in which were comprised many of the leaders in gas manufacture in this northern part of the kingdom. Possibly not much was said which would benefit the manager of a large gas-works, though Mr. Wilson, of Coatbridge, was certainly right when he pointed out that the large manager was always learning from the small one; but the proportion of large to small managers is so slight that the meeting would be a failure which only aimed at instructing the former class. It is the work-a-day spirit which pervades these spring meetings that constitutes their charm; and this year the heartiness with which ideas were exchanged, and the kindly spirit of co-operation which was manifested, were worthy of special admiration. While this spirit animates those who attend these meetings, the gas manager who stays away from them is a loser, and he who attends the most has the greatest gain. If there should breathe a manager with "soul so dead" to the advantages of comradeship, or if there exist a board of directors or corporation committee with minds so obtuse as not to understand what they would gain by allowing their manager to "go from home a little" and see the world, let each repent, and let the manager be henceforth sent, with his expenses paid, to these Association meetings; and his employers will find that not only will he pick up information which will be useful to them, but that the kindly encouragement accorded to him will incite their manager to do better things for them than he has ever attempted. Letting this suffice for generalization, it will, I think, be readily conceded that the Waverley meeting acted wisely in resolving to lend their aid to the North British Association in their endeavour to standardize meter unions. I cannot understand the action of the Board of Trade in this matter. What have the officials of the Board to do with anything which may be attached to a gas-meter, if it does not interfere with its efficient working? Could they object to a gas consumer ordering a meter to be made of wood, or clay, or even of gold, if he chose? I think not. Could they object to the clock-work being jewelled? I think not. Can they even prescribe the number of wheels in the clockwork, or the size of the dial-plate? I think not. Then what have they to do with the size of the pipe which supplies a meter, or with the particular thread of the screw which takes hold of the meter? It is apparent, however, that so long as the Board of Trade maintain their present attitude, the standard set which the North British

Association have procured cannot be brought into use. The set which the Department own surely cannot be of much value, or it would not have lain for ten years without having been used; and this being so, the Department would, I think, act with good grace if they left to those who understand the business to apply to it the outcome of their own studies. It is difficult to get the better of a Government Department. Practical unanimity will be necessary if these North British standards are to succeed. "Kindred Associations" should note this, and consider well before deciding what their action is to be.

The curious announcement is made from Perth that the Gas-Works Committee have had recently under consideration a letter from the Treasurer, in which he stated that the banks were declining to take the pence collected in the "slot" meters. It was remitted to the Convener and Treasurer to make inquiries as to how the accumulation of coppers might be disposed of. At a subsequent meeting, the Chairman reported that a satisfactory arrangement had been arrived at with the bank for the disposal of these coppers.

It is also intimated from Perth, in connection with the erection of the new gas-works, that Mr. John West, of Manchester, has replied to the Gas Commission that his Company have, in the meantime, stopped the construction of works under contract with the Commission, and that he will be pleased to consider the matter of reducing the size of the contract with the Commissioners or with the Engineer whom they may appoint. The Works Committee have written thanking Mr. West for his offer.

Regarding the Edinburgh and Leith gas coal contracts, of which I wrote last week, my attention has been called to an article on the subject which appeared in a Glasgow newspaper on Tuesday. I think it is not difficult to see in the article a trace of disappointment on the part of whoever inspired the writer, at not obtaining part of the order. The burden of the article is that the Corporation have not bought so much west country coal as they used to do, but have gone in largely for Lothians and Fife coal. Surely this is right on the part of the Commissioners, because the carriage will be less. I learn that the average reduction of 3d. per ton, which last week I attributed to the use of the carburetted water-gas plant in the Edinburgh works, cannot really be so, because the reduction applies to the purchases for Leith, where carburetted water gas is not used; but that the same proportions of coal have been purchased for the ensuing year's carbonizing as before, because, owing to physical conditions, if the carburetted water-gas plant be employed, it cannot be used as an enricher. The 3d. per ton reduction has been obtained simply by making a suitable selection of the many coals which were offered. Carburetted water gas, I understand, is only being manufactured to the extent of about one-half of what it might be. As to the withdrawal of tenders, it appears that the Commissioners were protected, by the terms of the tenders, from withdrawal within a certain period, and that they closed the contracts before that time expired.

Treasurer M'Crae, of Edinburgh, was the principal speaker at a meeting of the electors of the ward he represents in the Town Council. He said that in regard to both the Water Trust Bill and the Gas Commission Bill it was extremely unfortunate that these two undertakings, involving the expenditure and administration of such a large amount of money, were not directly under the control of the Corporation. As a member of the Water Trust, he said that, had the water been directly under the control of the Town Council, the difficulties with the Clippens Oil Company would never have arisen; and the more he saw of the working of these departments, the more was he convinced that for economy and efficiency it was essential that those two monopolies should be directly under the control of the Town Council, and worked by a Committee of the Town Council. If there was no prospect of amalgamation with Leith in the near future, some steps must be taken to put these bodies on another footing. He thought the Gas Commission had erred, even from the selfish standpoint, in increasing the rate for public lighting, because by doing so they were directly tempting the Town Council to go in for more electric light. But the Town Council were just going rather far ahead with public electric lighting; and if the proposals for the extension now before them were given effect to, along with the increased price of the gas for public lighting, their expenditure for public lighting in the coming year would be about £20,000, which would mean that there would be an increase of nearly ½d. per pound on the rates. Regarding increases of salaries, he said the Town Council should not be niggardly; but there was great danger in wholesale increases. The question of increase of salaries was almost as infectious as measles; and it was much more permanent in its results. He hoped the cabling of the tramways would soon be completed; and when that was done, they would have an annual revenue from the tramways of fully £70,000. Of this, £20,000 a year would be clear profit to the Corporation; and the system would be one of the finest in the world. As to all this, I only say that Treasurer M'Crae expected to have been Lord Provost of Edinburgh by this time; and, as he is not, these remarks sound very like a disappointed man's lament. He is a member of the Water Trust; and yet he allowed them to drift into the litigation with the Clippens Oil Company. He is not a member of the Gas Commission; and it is as well managed as any board in the country. His criticism of them goes for nothing, except with the ignorant portion of the electorate. I have given the Treasurer's remarks about the tramways, because it is his pet scheme; and it looks to be the shakiest of all the public doings of the Corporation of Edinburgh in recent years. The large profit he anticipates from the tramways is to be derived from a payment by the lessees of 7 per cent. upon the capital outlay of the Corporation upon the undertaking. Meantime, the Corporation are making money flow like water. It is not the interest of the lessees to object to this, because they are the contractors for the construction of the lines; and they are earning profit upon that. It does not seem to strike Treasurer M'Crae and his supporters that there is such a thing as a possibility of the lessees not being able to pay 7 per cent. upon the capital; and that then the Corporation would require to modify the payments, or to have the undertaking thrown upon their hands for good or for bad. Those who live in glass houses should not throw stones.

The Corporation of Stirling have resolved to oppose the Bill of the Stirling Gaslight Company when it comes before the House of Commons, and that notwithstanding their ignominious defeat before the House of Lords Committee. One of the weapons which they think will have effect is a proposal to compel the water supply of the town not only to moisten

GAS AND WATER COMPANIES STOCK AND SHARE LIST.

Referred to on p. 877.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.	GAS COMPANIES.			£ s. d.
500,000	10	Apl. 15	10½	Alliance & Dublin 10 p. c.	23—24*	..	4 7 6
100,000	10	„	7½	Do. 7 p. c.	16—17*	..	4 8 3
300,000	100	Jan. 3	5	Australian 5 p. c. Db.	105—107	..	4 13 6
200,000	5	Nov. 11	6½	Bombay, Ltd.	5⅞—6½	..	5 4 0
40,000	5	„	6½	Do. New, £4 paid	4⅞—5½	..	4 19 1
880,000	Stk.	Feb. 21	12	Brentford Consolidated	293—298	..	4 0 6
240,000	„	„	9	Do. New	3 18 11	..	
50,000	„	„	5	Do. 5 p. c. Prf.	140—145	..	3 9 0
159,375	„	Dec. 15	4	Do. 4 p. c. Db. Stk.	134—138	..	2 18 0
220,000	Stk.	Mar. 30	11½	Brighton & Hove Orig.	270—275	..	4 3 8
218,820	„	„	8½	Do. A. Ord. Stk.	195—200	..	4 5 0
933,500	Stk.	Feb. 24	5	Bristol, 5 p. c. max.	127—132	..	3 15 9
420,000	20	Mar. 30	11½	British	55—56	..	4 0 4
50,000	10	Mar. 11	11½	Bromley, Ord. 10 p. c.	25—27	..	4 5 2
75,000	10	„	8½	Do. 7 p. c.	20—22	..	3 17 3
500,000	10	Oct. 14	6	Buenos Ayres (New) Ltd	9—9¼	−¼	6 6 4
98,122	Stk.	Dec. 30	4	Do. 4 p. c. Db. Stk.	98—100	..	4 0 0
150,000	20	Mar. 11	8½	Cagliari, Ltd.	30¾—31½	..	5 4 9
100,000	10	Sep. 30	8	Cape Town & Dis., Ltd.	16—17	..	4 14 2
50,000	50	Nov. 2	6	Do. 6 p. c. 1st Mort.	59—61	..	4 18 5
550,000	Stk.	Apl 15	13½	Commercial Old Stock	330—335*	−3½	4 0 7
200,750	„	„	10½	Do. New do.	250—255*	+½	4 2 4
200,750	„	Dec. 15	4½	Do. 4½ p. c. Db. do.	154—157	..	2 17 4
800,000	Stk.	Dec. 15	12	Continental Union, Ltd.	225—235	..	5 2 2
200,000	„	„	9	Do. 7 p. c. Prf.	207—212	..	4 4 11
51,600	Stk	Feb. 21	14	Croydon A 10 p. c.	310—315	..	4 8 11
168,400	„	„	11	Do. B 7 p. c.	255—265	..	4 3 0
535,000	Stk.	Feb. 24	5½	Crystal Palace Ord. 5 p. c.	128—133	..	3 18 11
60,000	„	„	5	Do. 5 p. c. Prf.	140—143	..	3 9 11
486,090	10	Jan. 27	11	European, Ltd.	23½—24½	−½	4 9 9
354,060	10	„	11	Do. £7 10s. paid	17—18	..	4 11 9
5,922,110	Stk.	Feb. 10	12¾	Gaslight & Coke, A, Ord.	282—287	+2	4 9 0
100,000	„	„	4	Do. B, 4 p. c max.	118—123	..	3 5 1
665,000	„	„	10	Do. C, D, E, 10 p. c. Prf.	305—315	..	3 3 6
30,000	„	„	5	Do. F, 5 p. c. Prf.	150—155	..	3 4 6
60,000	„	„	7½	Do. G, 7½ p. c. do.	220—225	..	3 6 8
1,300,000	„	„	7	Do. H, 7 p. c. max.	195—200	..	3 10 0
463,000	„	„	10	Do. J, 10 p. c. Prf.	305—315	..	3 3 6
476,000	„	„	6	Do. K, 6 p. c. Prf.	184–189	..	3 3 6
1,061,150	„	Dec. 15	4	Do. 4 p. c. Db. Stk.	133—136	..	2 18 10
294,850	„	„	4½	Do. 4½ p. c. do.	153—155	..	2 18 1
958,000	„	„	6	Do. 6 p. c. do.	202—207	..	2 18 0
70,000	10	Oct. 28	8	Hongkong & China, Ltd.	14—15	..	5 6 8
3,900,000	Stk.	Nov. 11	10	Imperial Continental	213—218	..	4 11 9
376,400	100	Feb. 1	4	Do. 4 p. c. Dbs. Red.	98—101	..	3 19 3
473,600	Stk.	Feb. 10	3½	Do. 3½ p. c. Db. Stk.	103—106	..	3 6 0
560,000	100	Apl. 1	5	Met. of Mel- bourne 5 p. c. Db. 4½ p.c. Db.	110—112	..	4 9 3
					107—109	..	4 2 7
250,000	100	„	4½				

* Ex div.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.
75,000	5	Dec. 15	6	Malta & Medn., Ltd.	5½—6	..	5 0 0
541,920	20	Nov. 11	5	Monte Video, Ltd.	15—16	..	6 5 0
617,946	Stk.	Feb. 24	9½	Newc'tle & Gatesh'd Con.	235—240	..	4 1 3
252,355	Stk.	Jan. 3	3½	Do. 3½ p. c. Db. Stk.	115—120	..	2 18 4
150,000	5	Nov. 26	8	Oriental, Ltd.	8—8½	..	4 14 2
135,000	5	„	8	Do. New, £4 10s. pd.	7—7½	..	4 16 0
15,000	5	„	8	Do. do. 1879, £1 pd.	1½—2	..	4 0 0
60,000	5	Mar. 11	7	Ottoman, Ltd.	4⅞—5	..	7 0 0
420,000	100	Nov. 2	6	People's Gas 1st M. Bd.	104—109	..	5 10 1
500,000	100	Dec. 1	6	of Chicago 2nd do.	103—108	..	5 11 1
848,070	10	—	—	River Plate Ord.	1⅛—9⅜	..	—
250,000	Stk.	Jan. 27	4	Do. 4 p. c. Db. Stk.	99—101	..	3 19 3
250,000	10	Sep. 30	10	San Paulo, Ltd.	16—17	..	5 17 3
135,000	Stk.	Mar. 30	10	Sheffield A.	245—248	..	4 0 8
209,053	„	„	10	Do. B.	245—248	..	4 0 8
447,427	„	„	10	Do. C.	245—248	..	4 0 8
5,531,250	Stk.	Feb. 24	5½	South Metrop., 4 p.c Ord	135—138	−1	3 16 1
1,460,000	„	Jan. 13	3	Do. 3 p. c. Db. Stk.	103—106	..	2 16 7
60,000	Stk.	Mar. 11	12	Tottenham and A.	285—295	..	4 1 4
60,000	„	„	9	Edmonton B.	205—215	..	4 3 9
182,380	10	Dec. 20	7	Tuscan, Ltd.	13¾—14½	..	4 16 7
149,900	10	Jan. 3	5	Do. 5 p. c. Dbs. Red.	100—103	..	4 17 1
				WATER COMPANIES.			
746,164	Stk.	Dec. 30	10½	Chelsea, Ord.	320—330	..	3 3 8
150,000	„	„	5	Do. 5 p. c. Prf.	177—180	..	2 15 6
160,000	„	„	4½	Do. 4½ p.c. Pf. Stk., 1875	157—160	..	2 16 3
175,785	„	Mar. 30	4½	Do. 4½ p. c. Db. Stk.	158—163	..	2 15 3
1,720,560	Stk.	Apl. 15	8	East London, Ord.	223—228*	..	3 10 2
654,740	„	Dec. 30	4½	Do. 4½ p. c. Db. Stk.	158—166	..	2 14 3
390,000	„	„	3	Do. 3 p. c. Db. Stk.	105—107	..	2 16 1
700,000	50	Dec. 15	7½	G'd Junct'n, 10 p. c. max.	119—123	..	3 1 0
310,000	Stk.	Mar. 30	4	Do. 4 p. c. Db. Stk.	143—148	..	2 14 1
708,000	Stk.	Feb. 10	13	Kent	358—363	..	3 11 8
160,000	„	„	7	Do. New, 7 p. c. max.	218—218	..	3 4 3
1,043,800	100	Dec. 30	10	Lambeth, 10 p. c. max.	298—303	..	3 6 0
406,200	100	„	7½	Do. 7½ p. c. max.	228—233	..	3 4 4
350,000	Stk.	Mar. 30	4	Do. 4 p. c. Db. Stk.	140—145	..	2 15 2
500,000	100	Feb. 10	13	New River, New Shares	443—448	..	2 18 1
1,000,000	Stk.	Jan. 27	4	Do. 4 p. c. Db. Stk.	142—147	..	2 14 5
902,300	Stk.	Dec. 15	6	Southw'k & V'xhall, Ord.	155—160	..	3 15 0
126,500	100	„	6	Do. do. 7½ p. c. max.	152—157	..	3 16 5
489,200	Stk.	„	5	Do. do. 5 p. c. Prf.	174—179	..	2 15 10
1,019,585	„	Apl. 15	4	Do. 4 p. c. A Db. Stk.	143—146*	−1	2 14 10
1,155,066	Stk.	Dec. 15	10	West Middlesex	303—308	..	3 4 11
200,000	„	„	4½	Do. 4½ p. c. Db. Stk.	160—165	..	2 14 7
200,000	„	Mar. 11	3	Do. 3 p. c. Db. Stk.	105—107	..	2 16 1

* Ex div.

their clay, but to give them light for the operation. Professor Kennedy recently reported that they had not sufficient available power from the water supply to generate electricity; but they threw his report aside, and have obtained one from Mr. R. F. Yorke, of Fort William, on the subject. Mr. Yorke's report was submitted to a meeting of the Police Commission on Monday. He states that he finds that, by utilizing the available water power, the Commissioners may obtain a constant guaranteed output of 54 brake horse power from the turbines, which, after allowing for losses in the dynamo, cable, and electric storage, is capable of producing a supply of 618 units per day, which is sufficient for supplying the extended area of the town with 8000 lamps of 8-candle power connected, or one lamp for every two inhabitants. If in the future additional power was required, it could be obtained from No. 4 reservoir, at present untapped, to the extent of 4000 more lamps. The capital outlay he estimates at £13,500; and allowing £675 per annum for interest and sinking fund, which was 5 per cent. on the capital outlay, the total annual cost on the undertaking would be £1325. Taking 100,000 units as the number to be sold per annum, and charging at the rate of 4½d. per unit (which was considered to be equivalent to gas at 2s. 6d. per 1000 cubic feet), the revenue produced would be £1875 per annum—thus leaving a clear profit of £550. This profit, however, would not be realized until the full number of lamps had been taken up. In a note to his report, Mr. Yorke deals with the question in the event of large extensions being required in the future. If it were necessary to make the annual output 200,000 units, three gas or oil engines of 50-horse power each would be required in addition during the four winter months; but the cost of the light would be reduced. On the recommendation of the Lighting Committee, it was remitted to them to see whether the necessary consents and wayleaves could be obtained. Now all this looks very pat; but when it is remembered that Professor Kennedy found there would be only 30-horse power available, and that it would not do, I apprehend that reasonable people will have their doubts as to the feasibility of Mr. Yorke's scheme. But perhaps it does not matter much; if the report had once served its purpose of influencing the House of Commons Committee, it may not be heard of again.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *April* 16.

Sulphate of Ammonia.—The market has been quiet, and barely steady; and business has been much interrupted by holidays. Closing quotations are £8 15s. to £8 16s. 3d. per ton f.o.b. at the ports. Export buyers continue to postpone their purchasing till the last moment; and orders placed have been mainly for immediate delivery. Home demand is well sustained; and a large proportion of production is being absorbed in this direction, so that stocks in the country are not accumulating. There has been rather more interest in the forward position—May-June—but prices obtainable for the season of small production do not tempt makers.

Nitrate of Soda makes no headway, notwithstanding unprecedented deliveries; spot quotation being 7s. 4½d. per cwt. for fine quality.

LONDON, *April* 16.

Tar Products.—The pressure to sell benzols from certain quarters has still further reduced the values of them. A large business has been done at prices quoted below, for several months forward. Unfortunately, the season is now too late for any important quantity of benzol to be taken up for enriching gas, which doubtless will be the case if the present low prices continue. The enormous increase in the production of benzols in Germany is the chief cause of the present collapse in price. Solvent and heavy naphthas continue in fair request; and quotations for them are steady. Creosote is firm; and carbolic acid is said to be a little stronger. A better tone pervades the market for naphthalene in its various forms, while a little more money is asked for the heavier tar oils. Pitch seems to have touched the bottom; and hopes are entertained that better prices will prevail next shipping season.

Average prices for the week are: Tar, 11s. to 14s. Pitch, east coast, 20s.; west coast, 17s. Benzols, 90's, 10d.; 50's, 1s. Toluol, 1s. 3d. Solvent naphtha, 1s. 3d. Heavy naphtha, 1s. 1d. Crude, 30 per cent. naphtha, 4½d. Creosote, 2⅜d.; liquid, 3d. Heavy oils, 45s. Carbolic acid, 60's, 2s. 1d. Naphthalene, 55s.; salts, 32s. 6d. Anthracene, "A," 5d.; "B," 4d.

Sulphate of Ammonia.—Buyers keep remarkably indifferent, having regard to the spring consumption of sulphate. A large home demand is springing up, doubtless due to the action of the Sulphate of Ammonia Committee. No important stocks exist in makers' hands; while many happily sold forward when prices were better. To-day's values may be taken at £8 12s. 6d. to £8 15s., less 3½ per cent. at all ports.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—With the continuation of the South Wales strike, and no present indication of an early settlement, an increasing pressure for supplies in all descriptions of fuel for shipment is generally reported throughout this district; and advanced prices are being obtained on special sales for prompt delivery. The inland trade is also being affected to the extent that with colliery proprietors now having a ready sale for all their surplus output pit prices necessarily tend to harden; and though it is only in exceptional cases where there is any actually announced advance on list rates, prices are firm at the maximum basis, and any downward move is for the present altogether checked. The better qualities of Wigan Arley are not quoted at anything under 10s. per ton; and in some cases 10s. 6d. to 11s. has been asked. Pemberton four-feet and seconds Arley are about 9s. to 9s. 6d. per ton; and common house coal, 7s. to 7s. 6d. The lower qualities of round coal have stiffened up considerably. Only recently there were sellers at under 6s. per ton at the pit; but now it would be difficult to place even inland orders below 7s., as all the supplies that collieries have to offer are moving off freely. Very much the same applies to engine classes of fuel. Notwithstanding an increased production of slack, any extra output is being readily sold for

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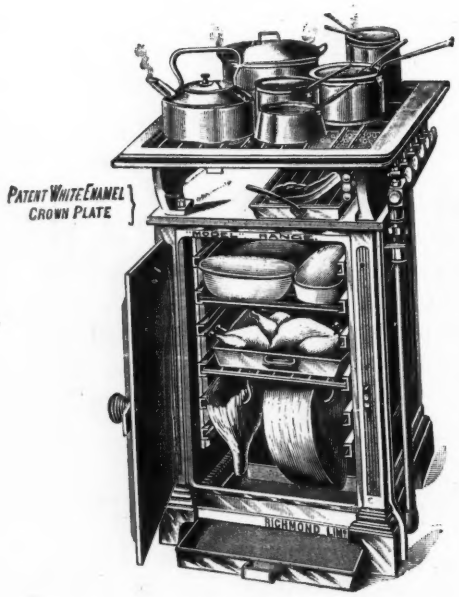

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shipment, while the inland demand is also generally fairly active. Common slack averages about 3s. 6d. to 3s. 9d. per ton; medium sorts, 4s. to 4s. 3d.; and best qualities, 4s. 9d. to 5s. For shipment, rates are irregular; sellers in most cases getting such prices as they can command, according to circumstances. The general advance would, however, represent about 2s. 6d. per ton on recent rates; ordinary steam coals fetching 10s. to 10s. 6d. per ton; and better qualities 12s. to 12s. 6d., delivered at Mersey ports. The exceptional pressure that has come forward for shipment will, if the South Wales strike is at all protracted, necessarily have a material effect upon the prices for gas coal during the ensuing season; but it is too early at present to forecast in any reliable manner the probabilities as to the prices that may rule when contracts come upon the market. Some substantial advance on last season's rates is, however, already being talked of.

Northern Coal Trade.—There has been continued activity in the coal trade of this district; and prices have been higher alike for steam and gas coals. Best Northumbrian steam coals have been in such demand for many markets that the prices have risen to as high as 19s. per ton f.o.b. for such quantities as could be obtained; while steam smalls have advanced to 7s. Gas coal beyond that contracted for is quoted as high as 8s. 6d. to 9s. per ton f.o.b.; and some considerable sales at prices near these are known to have taken place. Manufacturing coals are quieter. Gas coke is in rather more limited supply; but there is a fairly full export demand. There is no change this week in the price.

Scotch Coal Trade.—As may be expected, the coal trade in Scotland has been greatly disturbed by the doings in Wales. A sudden outlet for Scotch coal has developed, and stocks are disappearing rapidly. It is impossible to state quotations of prices, because purchasers are giving largely in excess of recent market rates, and sellers do not care to communicate what they are obtaining. It may safely be said, however, that nothing under 10s. per ton f.o.b. Glasgow can be purchased. The miners, following up the situation, have demanded an advance of 1s. per day. This week the masters in the West conceded 6d. per day; but the offer has not been held to be sufficient, and the agitation for 1s. was continued. The latest reports are that many coalmasters have conceded the full demand; and the others are likely to follow. The reports of the shipments for the week have been dislocated by holiday and other causes; but it has been reckoned up that the total shipments for the year to date have amounted to 384,789 tons—an increase over the corresponding period of last year of 41,364 tons.

Bolton Gas and Water Supply.—At the Bolton Town Hall, last Friday, Colonel J. T. Marsh, R.E., held an inquiry respecting an application made to the Local Government Board by the Corporation for power to borrow £100,000 for gas-works purposes, and £9000 for the improvement of the water supply. The Town Clerk (Mr. R. G. Hinnell) addressed the Inspector in support of the application; and evidence was given by the Gas and Water Engineers (Messrs. W. Smith and R. H. Swindlehurst), the Borough Treasurer (Mr. G. Swainson), and the Chairman of the Gas Committee (Alderman Miles). There was no opposition.

Proposed Subway for Gas and Water Pipes at St. Helens.—At the meeting of the Water Committee of the St. Helens Corporation last Wednesday, the Water Engineer presented a report on a proposal to construct a subway along Church Street and Ormskirk Street, for the gas and water mains, &c. It appeared that both the Gas and Water Engineers and Borough Surveyor had visited London and Nottingham and inspected subways; and now recommended the construction at St. Helens of a subway 6 ft. 6 in. high by 5 ft. 6 in., with lateral ways at the junction of each street, and pipes through which could be carried the house services. The total estimated cost was £5300. It was stated that the Gas Committee had approved of the scheme, considering that it would be to the advantage of the public. There was some discussion on the subject; but there were differences of opinion as to whether the benefits to be derived would be commensurate to the cost. It was suggested that the question should be referred to the Chairmen and Vice-Chairmen of the Finance, Water, Gas, and Highways Committees. This was agreed to—the Committee approving of the idea of a subway, but leaving to the consideration of the Special Committee the question of cost.

Electric Lighting and Water-Works Extensions at Wallasey.—Last Thursday, Mr. W. A. Ducat held an inquiry at Egremont in regard to applications made to the Local Government Board by the Wallasey District Council for power to borrow £20,785 for electric light extensions and £7350 for new water-mains, &c. In regard to the former amount, it was stated by the Clerk to the Council (Mr. H. W. Cook) that it was made up of £17,725 for extensions proper, and £3060 for street and promenade arc lighting. The electric light was installed in the district and first used in January, 1897. There were then 2000 8-candle lamps in connection with the supply; but now the number was between 5000 and 6000. The number of consumers was about 100. The profit for the eleven months ending March last was £840. Since the system was installed the price had been reduced from 7d. to 6d. per Board of Trade unit; and a reduction had also been made for prolonged consumption. The Council had already raised £17,500 for electric lighting; and for the present loan they asked for borrowing powers for the maximum period. Evidence was given in support of the application, to which there was no objection, by the Electric Lighting Engineer (Mr. J. H. Crowther). The application with respect to the water undertaking was for power to borrow £5600 with which to lay mains in new streets during the next seven years, and £1750 to supply new meters during the same period. Mr. Cook explained that the average expenditure on new mains during the past two years had been £700; and on new meters, £225. The amounts applied for were calculated on the cost of previous years; and borrowing powers were sought in order to obviate the necessity of constructing such works out of income, as this would be unfair to the ratepayers. He suggested that a return as to the new works should be furnished to the Local Government Board every six months; and added that it was not proposed to borrow the money in advance, but just as it was required. Dr. Oldershaw said the money would place the Council in the position of having an overdraft, and prevent unnecessary delay in putting down new mains. The inquiry then terminated.

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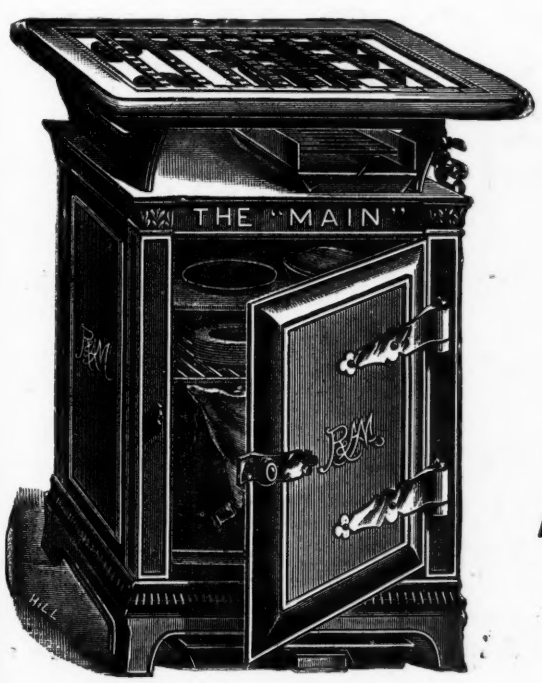

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Netherlands Incandescent Gas-Light Company, Limited.—The report of this Company for 1897 shows a profit of £6368; making with the balance brought forward £6501, out of which the Directors recommend a dividend of 10 per cent. It is proposed to write off £850 against the fluid supply contract.

Arundel Gas Company.—At the recent annual meeting of this Company, the Chairman (Mr. C. Bartlett), in moving the adoption of the report and accounts, stated that since the last meeting the Company's Bill had received the Royal Assent, and came into operation on the 1st of January last. He considered that, notwithstanding the very mild winter, the past year's operations had been satisfactory; the sale of gas having been the largest the Company had experienced. The usual dividends of 10 per cent. on the original, 7½ per cent. on the £10 shares, and 5 per cent. on the 1892 issue, were declared.

The Ramsbottom District Council and the Gas Undertaking.—In reply to a question raised at the monthly meeting of the Ramsbottom Urban District Council, the Clerk (Mr. J. W. Barlow) stated that the only offer, in reply to the Council's request, the Ramsbottom Gas Company had made for the sale of their undertaking was as follows: "That if the Council were prepared to offer a price sufficient to secure to the shareholders of the Company a maximum dividend in perpetuity, the Directors would call a meeting of the shareholders to consider the matter." In reply to a further question, the Clerk said the "maximum dividend" was 10 per cent. Nothing further had been done in the matter; and no other offer had been made on either side.

New Joint-Stock Companies.—A Company has been formed with a capital of £75,000, in £5 shares, to acquire the business carried on by Mr. J. Spencer at the Globe Tube-Works, Wednesbury, Staffs., and to manufacture, sell, and deal in iron, steel, brass, and metal tubes, compressed air tubes, and weldless and other tubes for boilers, cycles, and hydraulic purposes. The Sanitary Lead Lining and Pipe-Bending Company, Limited, has been registered with a capital of £25,000, in £1 shares, to acquire certain patent rights for improvements in drain and other metal pipes, and in connection with jointing pipes and pipe-bending machinery. The Victoria Tube Company, Limited, with a capital of £25,000, in £5 shares, will carry on the business of tube manufacturers at Great Bridge, Staffs.

A Leeds Woman Suffocated by Gas.—A verdict of "Death from misadventure" was returned at an inquest held at Leeds last Thursday on the body of Sarah Webster, aged 85, a widow, who lived with her niece at No. 28, Warwick Place, Leeds, and who died on the previous Tuesday from the effects of gas poisoning. On Sunday night the deceased complained of a smell of gas; and her niece, Mrs. Goddard, put some water into the chandelier. When Mrs. Goddard went into her aunt's room the following morning, she found it full of gas, and the deceased lying on the floor unconscious. A medical man was called in; but Mrs. Webster died without being able to give any explanation as to how the gas had escaped. From the position of the chandelier, however, it appeared that the deceased had pulled it down, unaware that this would cause gas to escape through the slide.

The Sufferers from the Maidstone Epidemic.—The Directors of the Maidstone Water Company have decided to vote £3000 for distribution among those sufferers by the typhoid epidemic who did not receive help from the Relief Committee, and who contemplated claiming compensation from the Company. The offer has been accepted.

An Explosion of Acetylene.—Owing to a leakage from a generator of acetylene gas lately fitted up at the stores of the Milnrow Conservative Co-operative Society, an explosion took place on the evening of the 7th inst., which gave a shock to, and slightly injured, several customers, and blew out all the lower windows. The lights in one department continued burning after the accident; and the generator was intact.

Abandonment of the Carrick-on-Suir Water-Works Scheme.—Owing to the opposition of the ratepayers, the Town Commissioners of Carrick-on-Suir have been obliged to abandon their scheme for supplying the town with a high-pressure water supply. Matters had got so far that preliminary plans had been prepared for obtaining water from Crotty's Lake, in the Comeragh Mountains, some five miles distant, the cost of which was to have been £8000.

Suffocation by Gas.—A domestic disaster occurred on the 9th inst. in Schaarbeek, a populous suburb of Brussels. A police inspector and his wife went away on Friday for a holiday, leaving their three children in charge of a widow, who temporarily occupied rooms on the first floor of the local police station. As no one appeared to be about on Saturday, the police forced the bedroom door, and found the occupants asphyxiated from gas that had escaped from an open burner. The eldest child had evidently attempted to reach the window to admit air, but had been overcome. One child was subsequently restored by artificial means; but the widow and the two other children—a girl of 14 and a boy of 10—were beyond medical aid.

Two Lives Lost through a Loose Gas-Tap.—During the Easter holidays, a double case of gas poisoning occurred at Bradford, under circumstances of an exceptionally painful character. Last Thursday week, Mr. and Mrs. Moore, of 53, Victoria Street, started on an excursion; leaving two sons (William and John, aged 18 and 16 respectively) in charge of the house. The parents arrived home again on Tuesday evening, but found the place locked up; and Mr. Moore had to obtain entrance by a window. Inside he noticed a strong smell of gas; and on proceeding upstairs to the attic where the boys slept, he found the gas almost overpowering. William he discovered on the bed quite dead; but the younger son was still breathing, although he must have been lying there unconscious since the Saturday night. At the inquest on Wednesday, Mr. Moore stated that he found the gas-tap in the room about half turned on. There was nothing defective in the bracket, excepting that the tap was loose and moved easily. There was no fire-place in the attic; the only ventilation being a skylight. Evidence was also given showing that the house was closed from Sunday morning to Tuesday night. The City Coroner adjourned the inquiry to the 26th inst., for the purpose of hearing the evidence of John Moore, who, however, died on Thursday morning. On the following day, an inquest was held on the latter; the jury returning a verdict of "Accidental death."

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Fylde Water-Works Company.—The half-yearly report of the Directors of this Company states that the capital expenditure of the six months has been £25,027—making a total of £434,307. This includes £65,062 paid towards the new works authorized by the Company's Act of 1896. Interest upon this outlay has been charged to revenue; but no income has yet been derived from it. The water rates and other receipts, after an allowance of £390 for empty houses, &c., and bad debts, amount to £18,493; interest on loans and bank commission, to £1148; and working expenses, rents, rates, and taxes, to £3835—leaving a balance of £13,509, which, with the amount brought forward (£12,455), makes a total balance of £25,965. The Directors recommend dividends at the rate of 4 per cent. per annum on the preference stock, 1891, and 10 and 7 per cent. per annum on the "A" and "B" stocks respectively, all less income-tax, leaving about £15,791 to be carried to the next account. The time for making the award under the arbitration for the purchase of the undertaking has, at the request of the authorities, been extended for a further six months.

The Falmouth Corporation and the Water-Works.—Although the Falmouth Corporation seem to have great difficulty in making up their minds as to what they really want, some further progress has been made with the scheme for the purchase of the water undertaking. At a meeting of the Corporation recently, the Gas and Water Purchase Committee presented a report in which they recommended that the Town Clerk should write to the Chairman of the Company stating that the Corporation desired to purchase the undertaking, and asking if the Company were prepared to sell, and, if so, at what price. It was also suggested that a Committee should be appointed to confer with the Penryn Corporation. In the course of the discussion, several members expressed approval of the course suggested by the Committee, though Mr. Grose reminded the Council that in 1895 the Company informed the Corporation that there was no intention to sell the undertaking. Mr. Walton thought they ought to take Counsel's opinion, so as to know how to be able to act. The action of the Company in regard to filtration ought to be watched. Then the Company were not taking any action to remedy the choked pipes which existed all over the borough. Mr. Coombes seconded an amendment moved by Mr. Walton in favour of the employment of Counsel, and expressed the opinion that they had come to the position when the Company were going to defy them on the Acts of Parliament. The amendment was in the end withdrawn, and the recommendation of the Committee adopted.

Plymstock Water Supply.—An inquiry respecting an application by the Plympton St. Mary Rural District Council for permission to borrow £7350 for the water supply of Plymstock and the neighbouring villages has lately been held by Major-General H. D. Crozier, R.E., one of the Local Government Board Inspectors. This was the second application in regard to the same matter. In 1896, as the result of the evidence given respecting the existence of an abundant supply of water in the parish, the Board directed that trial pits should be sunk. Mr. Foote, Q.C., who now appeared for the Council, said the pits had been made, and the result was to confirm the opinion expressed on behalf of the Council at the former inquiry—that there was practically no water in the parish. Mr. H. Francis gave evidence as to the trial pits and the small yield of water which resulted; and he was confirmed by Mr. R. H. Worth. With regard to the proposed scheme for supplying water, Mr. Francis said the source from which the Plympton water was derived yielded 300,000 to 400,000 gallons per day. Plympton required about 50,000 gallons daily; and the remainder was running to waste. It was proposed that the minimum quantity to be supplied to Plymstock should be 20,000 gallons per day, for which the payment would be £445 per annum, including the parish's proportion of the interest and sinking fund. For 30,000 gallons the charge would be £475; for 40,000 gallons. £506; and for 50,000 gallons, £536. The Inspector said the size of the mains would have to be increased from 2 up to 3 inches. He thought the reservoir could be made much cheaper than was proposed if concrete were used. A great deal of money was needlessly wasted because people did not think concrete could be made water-tight; but all that was wanted was a clerk of works who thoroughly understood his business. The Medical Officer of Health (Dr. Scott) gave evidence of the urgent need of a water supply; and several ratepayers were heard in opposition to the scheme. One of these said he believed that as much water was going to waste in the parish as was running into Plymouth.

Frank Wright's Prepayment Gas-Meter Corporation, Limited.—The third annual general meeting of this Company was held at the Cannon Street Hotel, E.C., on the 5th inst.—Mr. G. R. Burn in the chair. In moving the adoption of the report and accounts, the Chairman said it must be admitted that the balance-sheet was not a very satisfactory one, though it was very much better than that of the previous year. The shareholders would remember that at the last meeting reference was made to certain improvements which were being made in their meter. They did not put it on the market until the latter part of 1897—until they had brought it to such perfection that they could fairly offer it to the public. Therefore, for the first six months of that year very little business was done. Afterwards, however, the sales increased rapidly; and in December they were nearly six times as great as in June. In the first three months of the present year this rate of progress had been maintained. The meter had now obtained a firm hold with a great number of gas companies; and the Directors had arranged a contract with the London, Brighton, and South Coast Railway, to supply the meters for their entire system until the end of April, 1899. During 1897, about 1900 meters were sold and delivered, exclusive of repairs. The financial part of the business was not particularly satisfactory. They had had to borrow £6000, which was secured upon the freehold premises, and to the extent of £3000 by the guarantee of Mr. Moeller, Mr. de Fonblanque, and himself. They were therefore personally liable for the repayment of one-half of the £6000. The fact that they had guaranteed this sum was, he thought, evidence of their belief in the Company. The Board were of opinion that they ought to raise £10,000 on 6 per cent. preference shares. A suggestion had been put forward that the Company should amalgamate with the Universal Meter Company; but he confessed he did not know sufficient of the other Company to approve of the proposal. Mr. de Fonblanque seconded the motion; and, after some discussion, it was carried. The question of amalgamation was left for the consideration of the Directors. All these gentlemen, as well as the Auditors, were re-elected; and the proceedings closed.

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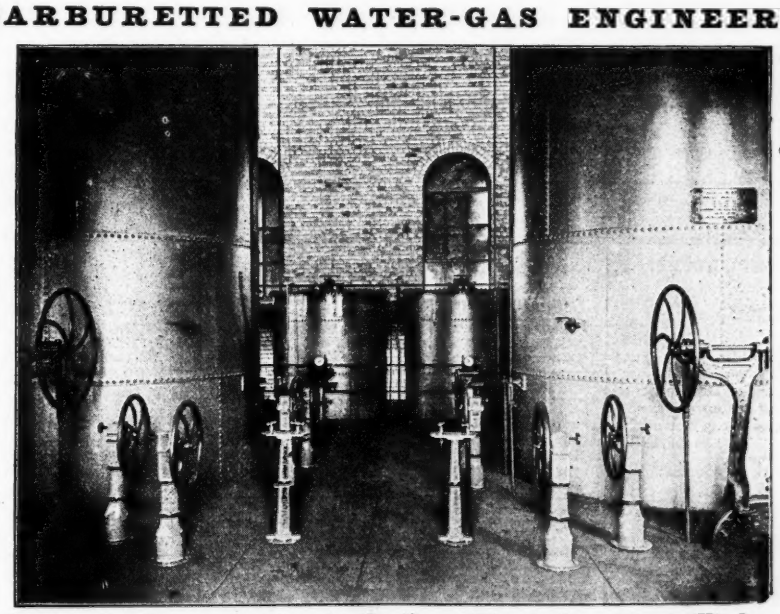

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Aberdare Water-Works.—Last Thursday, Colonel Slacke, R.E., held an inquiry at Aberdare relative to an application by the District Council for the sanction of the Local Government Board to an additional loan of £15,000 required to complete the new water-works. The Consulting Engineer (Mr. W. Fox) and others gave evidence, after which the Inspector expressed himself very satisfied with the inquiry and with a visit he had paid to the works.

Tarapaca Water-Works Company, Limited.—According to the report of the Directors of this Company for the past year, the assets and liabilities in Chili have been converted at the exchange of 17½d. per dollar—the same as at the close of the previous year. The net profit amounts to £40,404, which, added to the balance brought forward—namely, £17,393—makes a total to the credit of the profit and loss account of £57,797. Out of this an interim dividend was paid in October last at the rate of 3½ per cent., absorbing £14,000. The Directors now propose to pay a final dividend of 4 per cent. (£16,000), making 7½ per cent. for the year; to place £10,000 to the account for the redemption of the debentures and £10,000 to the general reserve; and to carry forward the balance. Considering the great depression in the nitrate industry, the water deliveries have been fairly maintained. Another spring at Pica was purchased during the past year.

An "advance issue" of Messrs. Richmond and Co.'s new 16-page summer list has just been sent out in temporary cover. Special attention is devoted to "slot" cookers, several new patterns of which are shown.

The Darwen Corporation have accepted the offer of Messrs. W. & B. Cowan, Limited, for the supply of two 20-inch William Cowan's patent governors, one of which will be operated by Mr. Cowan's patent electrical pressure system.

The annual contract for iron pipes, &c., for the Gas Committee of the Birmingham Corporation has been placed with Messrs. J. & S. Roberts, of the Sun Foundry, West Bromwich. It covers a large quantity of material, and extends to the end of March next year.

The report of the Directors of Messrs. James Milne and Son, Limited, for the past year, which has just been adopted, recommended that the following dividends should be declared: On the preference and ordinary shares, 6 per cent. per annum; on the deferred shares, 20 per cent. per annum. The balance of profit, amounting to upwards of £1700, remaining after payment of these dividends, is being carried forward. The reserve fund has been increased to £7187 10s., over and above the amount carried forward.

The Trades and Commerce Exhibition Syndicate, which was established by Messrs. Richmond and Co., Limited, last year, has proved a great success, and embraces practically the largest firm in each industry which is exhibited. The combined capital of the members amounts to several millions. Recent exhibitions have been held in a number of towns in the South of England; and a similar Syndicate is touring the North and the Midlands, with satisfactory results. It is now in the Potteries.

Our readers will see, by an advertisement which appears elsewhere, that the St. Neots Water Company, which was incorporated by an Act passed last session, are about to issue at par 900 ordinary shares of £10 each, which may rank for dividends up to 10 per cent. The area to be served by the Company comprises the town of St. Neots and the parishes of St. Neots Rural and Eynesbury-Hardwicke; and the population to be supplied is about 5000. Works have been designed for furnishing 100,000 gallons of water daily; and they will be commenced at once. The Urban District Council of St. Neots have power to purchase the undertaking. The list will close on or before Saturday next.

Very successful exhibitions of gas appliances, with cookery demonstrations, have recently been held in various parts of the country. Messrs. R. & A. Main, Limited, exhibited in Edinburgh, Kirkintilloch, and Harpurhey (Manchester); Miss Dods giving the demonstrations. Messrs. W. Parkinson and Co. held an exhibition in the Workmen's Hall, Colwall, from Wednesday to Friday last; cookery lectures being delivered twice daily by Miss Edith Sanderson. In the past week, Messrs. Richmond and Co., Limited, held exhibitions at Manchester, Edinburgh, Walkden, and Hurst; cookery demonstrations being given by Miss Lillie Richmond, Mrs. J. J. Middleton, Miss Smallwood, and Miss Laverock. They also exhibited at Barnstaple, with lectures by Miss Annie Stansfield, and in the Crystal Palace Gas Company's district at Norwood, with lectures by Miss Clara Lennard. The humorous lantern lecture with cinematograph was at both places successful, and drew crowded audiences, particularly at Norwood.

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[For Illustrated Advertisement, see April 5, p. 794.]

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Telegrams: "HUTCHINSON BROS., BARNSLEY."

NOTICE TO ADVERTISERS.—COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office *not later* than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or Stoppages of, PERMANENT ADVERTISEMENTS should be received not later than the FIRST POST on SATURDAY.

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GAS CARBON Wanted, not less than 4-Ton Loads.
Apply to the BRIMINGTON CARBON COMPANY, Sowerby Bridge, YORKS.

SADLER & CO., Ld., Middlesbrough; ULVERSTON (BARROW); PORTSMOUTH; CARLTON (N.E.R.); and STOCKTON. Tar and Petroleum Distillers. Benzol and Petroleum Spirit, 700 and other Gravities specially prepared for Carburetting. SOLAR OIL for Gas Making, Kerosene, &c.
Correspondence invited.
Telegraphic Address: "SADLER, MIDDLESBROUGH."

NEW GAS PLANT CEMENT.

JOHN E. WILLIAMS AND CO.,
VICTORIA PAINT WORKS,
MANCHESTER.
For all Joints in connection with Oil-Gas Plant and Sulphate Plant.
For all Gas Joints.
For all Tar Joints.
For all Ammonia Joints.

CANNEL, COAL, ETC.

JOHN ROMANS & SON, EDINBURGH, Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS and WATER WORKS.
Prices, &c., will be forwarded on application to No. 80, ST. ANDREW SQUARE, EDINBURGH, / NEWTON GRANGE, NEWBATTLE, DALKEITH, } SCOTLAND.

IMPORTANT.

OLD Retorts made equal to new by repairing them with CROWTHER'S PATENT STICKFAST FIRE CEMENT. Unequalled for Repairing Inclines. Can be used in Hot or Cold Retorts; and "A1." for Mouthpiece Joints. Satisfaction Guaranteed.
CROWTHER, Practical Retort Setter, Manor Street, HUDDERSFIELD.

Price 2s., Post Free.

STEPHEN CARPENTER, on the Puri- FICATION OF COAL GAS BY LIME, OXIDE OF IRON, AND ATMOSPHERIC AIR, and the Method of Working Purifiers so that the Lime may be used a second time, with a Description of Carpenter's short Method of Working off the Sulphur Test, and Table for Calculating Results.
S. CARPENTER, Ryde House, 28, Woodhouse Grove, East Ham, ESSEX.

HYDRATED OXIDE OF IRON.

PREPARED from pure Iron.
Two or three times as rich as Bog Ore.
Strong action on Sulphuretted Hydrogen.
To be used alone, but will increase activity of other Oxides.
Less than half the price of Bog Ore.
Can be lent on hire.
Write for tabulated results.
READ HOLLIDAY AND SONS, LIMITED, HUDDERSFIELD.

WANTED, Retort Setters.
Apply to the LEEDS FIRE-CLAY COMPANY, LIMITED, Engineering Department, Wortley, LEEDS.

STOKER wanted, used to Shovel Charging. Constant employment for a sober and industrious Man. Wages 31s. per week.
Apply, by letter, to No. 3043, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a steady reliable Man as leading STOKER at small Gas-Works near London. Abstainer preferred. Wages 32s. per week.
Apply, by letter, with Testimonials, to No. 3041, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, temporarily, at a Gas-Works in the Midlands, an experienced DRAUGHTSMAN.
Apply, at once, by letter, with Terms and References, to No. 3037, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a Gas-Fitter (young Man), used to Compo. and Iron Fittings for inside work, Service Laying, Meter Fixing and Reading, and willing to make himself generally useful.
Apply, by letter, with References, to No. 3038, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

GAS TUBES AND FITTINGS.

OLD-Established Manufacturer requires an AGENT calling upon all Gas Companies in the United Kingdom. Must have good Connection. Liberal Commission.
Address No. 3039, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, an experienced Man to take sole charge of a small Country Gas-Works in Hertfordshire. Annual make, 2½ millions. Assistance in Winter Months. Wages 25s. per week, with House, Coal, and Gas, and Bonus on good results.
Address, with character, No. 3042, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

TO PIPE LAYERS.

WANTED, a thoroughly good Work- man, to lay and joint about 1000 yards each of 5-inch and 4-inch GAS-MAINS; also for permanent employment a young GAS-FITTER to lay Services and fit up Houses with either Iron or Compo.
Apply, by letter, with References, to No. 3040, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

GUILDFORD GASLIGHT AND COKE COMPANY.

WANTED, a thoroughly competent FITTER, who could take charge of the Machinery—Steam and Hydraulic—at the above Works.
Applications, stating Age, Experience, and Wages required, to be sent, not later than Friday, the 22nd inst., to the SECRETARY, Gas Offices, GUILDFORD.

REQUIRED a few young Gas Engineers, with a good sound technical knowledge of gas matters. Those with commercial experience preferred. Permanent employment to good Men.
State Particulars of previous Experience, References, Age, and Salary required, by letter only, to the GENERAL MANAGER, Welsbach Incandescent Gas-Light Company, Limited, Palmer Street, WESTMINSTER. None but first-class Men need apply. All communications will be treated privately.

WANTED, as working Manager of the Hoylake and West Kirby Gas and Water Company, Limited, a practical and experienced Man, capable of managing both Gas and Water Works.
Applications, by letter only, stating Experience and Wages required, must be delivered to the undersigned not later than Monday, the 25th inst.
By order of the Board,
ARTHUR GEO. READDY,
Secretary.
8, Filey Terrace, Hoylake,
April 14, 1898.

WANTED, for the Midland Counties, a thoroughly sober and well-qualified WORKING MANAGER, to take charge of, and perform all the duties of, a Gas-Works making about 5 million cubic feet of Gas per annum.
Preference will be given to one who can lay Mains and Services and fix Meters. Assistance will be provided during the four Winter Months. Wages 26s. per week, with House, Coal, and Gas free. Applicants must state Age, Experience, and whether Married or Single.
Apply, by letter, to No. 3035, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

EXHAUSTER, &c., WANTED.

ONE Second-hand Engine and Exhauster (Rotary), in good condition, 15,000 cubic feet per hour, three Blades, with 8-inch Valves and Connections, and 8-inch Bye-Pass Valve; one GAS GOVERNOR; and one GAS THROTTLE VALVE. Also a Second-hand CLAPHAM ("Eclipse") WASHER, 250,000 feet per day.
State Price and all Particulars to HERBERT NIVEN, Engineer and Manager, Gas-Works, Gomersal, near LEEDS.

WANTED, Carbon in 4 Ton Lots, or more.
State Price, f.o.r. at nearest Station, to No. 3031, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

PURIFIERS, &c., WANTED.

WANTED, a Four or Six Set of second- hand PURIFIERS, in good condition, not less than 20 feet square. Also a set of WROUGHT-IRON ANNULAR CONDENSERS, ½ to 1 Million capacity, either in single or double set.
Apply, in first instance, to No. 3034, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

EXHAUSTER for Sale, second-hand, Waller double-blade, capable of passing 17,000 cubic feet per hour. Price £15.
Apply to Mr. COOPER, Gas-Works, BANBURY.

FOR SALE—Two small Gas Exhausters (perfectly new); one combined with Steam-Engine.
Apply to SELLERS PICKERING & CO., Gas Engineers, RAVENSTHORPE, YORKS.

FOR SALE—A Small Gas-Works (Free- hold Property) near London. Production about 1 million.
Apply, in first instance, to No. 3036, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

ON SALE—Cast-Iron Ascension-Pipes, DIP-PIPES, MOUTHPIECES, VALVES, &c.
Further Particulars on application to
T. DUXBURY,
Manager.
Gas-Works, Middleton,
near Manchester.

GAS PLANT for Sale—I can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. **Compare Prices and Particulars before ordering elsewhere.**
J. F. BLAKELEY, Gas Engineer, Ravensthorpe, YORKS.

FOR SALE—A Modern Sulphate of AMMONIA STILL, built by Messrs. R. & J. Dempster, Manchester, 1893, with separate Liming Compartment. Capacity, with ordinary Liquor, 5000 to 6000 lbs. of Sulphate per day.
For further Particulars, apply to the BRYMBO STEEL COMPANY, LIMITED, near WREXHAM.

FOR SALE, Cheap—The under- mentioned GAS PLANT:—

	Ft.	in.	Ft.	in.	
	Square.		Deep.		
2 PURIFIERS,	5	0	4	0	4-in. Valves & Connections.
1 PURIFIER,	5	0	2	9	4 „ „ „
CONDENSER, 4 inches diameter, Vertical Pipes.					
EXHAUSTER (Gwynne's) 20,000 c.f. per hour 8-in. Valves					

Apply to SAML. WHILE AND SONS, 60, QUEEN VICTORIA STREET, E.C.

BOROUGH OF COLNE.
(GAS DEPARTMENT.)

THE Gas Committee invite Tenders for the supply of 500 yards of 14-inch CAST-IRON GAS-MAINS (uncoated).
Further Information can be obtained from the undersigned, to whom Tenders, endorsed "Mains," must be delivered on or before Saturday, the 23rd day of April, 1898.

HY. SIMMONDS, C.E.,
Engineer and General Manager.
Engineer's Office, Gas-Works,
Colne, April 7, 1898.

BOROUGH OF COLNE.
(GAS DEPARTMENT.)

THE Gas Committee invite Tenders for the surplus TAR made at their Works during the Year ending March 31, 1899. Estimated quantity 700 Tons.
Tenders, endorsed "Tar," to be delivered to the undersigned on or before Saturday, the 23rd day of April, 1898.

HY. SIMMONDS, C.E.,
Engineer and General Manager.
Engineer's Office, Gas-Works,
Colne, April 7, 1898.

BOROUGH OF BRIGHOUSE.

THE Gas Committee are prepared to receive TENDERS for the supply and delivery of GAS COAL and CANNEL and BUXTON LIME required at the Mill Lane and Birds Royd Gas-Works during the Year ending the 30th of June, 1899.
Specification and Form of Tender can be obtained on application at the Gas Engineer's Office, Mill Lane, Brighouse.
Sealed Tenders, stating Price per ton, delivered at the Gas-Works, or alongside the Gas-Works by the Calder and Hebble Canal, or at Brighouse Railway Station, must be sent in on or before Saturday, the 30th day of April, 1898, addressed to the Town Clerk, Public Offices, Brighouse, endorsed on the outside "Tender for Coal," or "Lime," as the case may be.
The lowest or any Tender not necessarily accepted.
By order,
JAMES PARKINSON,
Town Clerk.
Town Clerk's Office,
April 13, 1898.

TAR AND AMMONIACAL LIQUOR.

THE Accrington District Gas and Water Board are prepared to receive TENDERS for the TAR and AMMONIACAL LIQUOR which may be produced at the Accrington and Great Harwood Works of the Board during the Year from the 1st of July next to the 30th of June, 1899.

Estimated Total Quantity of Tar, 1700 Tons; Liquor, 4200 Tons.

Tenders, endorsed "Tar and Ammoniacal Liquor," must be in my hands on or before Tuesday, the 10th of May.

CHAS. HARRISON,
General Manager.

General Offices of the Board,
Accrington, April 16, 1898.

TODMORDEN CORPORATION.

TENDERS FOR STORES AND FITTINGS.

THE Gas Committee of the Todmorden Corporation are prepared to receive TENDERS for the supply of the necessary STORES AND FITTINGS, required by them for the ensuing Twelve Months ending March 31, 1899.

Forms of Tender and Specification, with full Particulars, can be obtained on application to the Engineer, Mr. Hy. Hawkins.

Tenders to be delivered at the Town Clerk's Office, Town Hall, Todmorden, addressed to the Chairman of the Gas Committee, on or before the 28th inst.

TO TAR DISTILLERS AND OTHERS.

THE Corporation of Birkenhead invite OFFERS for the Purchase and Removal of the surplus TAR produced at their Gas-Works during a period of One, Three, or Five Years, commencing on the 1st of July, 1898.

Deliveries will be made at the Gas-Works, either into Contractor's Tanks on the Gas-Works Railway Siding, or into Tanks for conveyance by road to Boats.

The Contractor whose Tender is accepted will be required to enter into a formal Contract or Agreement with the Corporation upon the specific Terms and Conditions contained in the Draft Contract, which has been prepared by the Town Clerk, and deposited in his Office for inspection.

Forms of Tender and further Particulars may be obtained from the Gas Engineer, Mr. T. O. Paterson, C.E., Gas-Works, Thomas Street.

Tenders, which must be on the printed form supplied, sealed and endorsed "Tender for Tar," to be sent in to me not later than Five p.m. on Tuesday, the 29th of April, 1898.

The Corporation do not bind themselves to accept the lowest or any Tender.

By order,
ALFRED GILL,
Town Clerk.

Town Hall, Birkenhead,
April 15, 1898.

ULVERSTON URBAN DISTRICT COUNCIL.

(GAS AND WATER DEPARTMENT.)

TENDERS FOR CANNEL.

THE Gas and Water Committee invite TENDERS for the supply of CANNEL COAL, for a term of One, Two, or Three Years commencing the 1st of July next.

Full Particulars and Forms of Tender may be had on application to the undersigned.

Sealed Tenders, endorsed "Tender for Cannel," must be sent in addressed to the Chairman of the Gas and Water Committee, not later than Thursday, the 28th inst.

JNO. SWAN,
Engineer and Manager.

April 16, 1898.

COUNTY BOROUGH OF BURY.

TO SULPHURIC ACID MAKERS.

THE Gas Committee of the Bury Corporation are prepared to receive TENDERS for the supply of about 350 Tons of SULPHURIC ACID for the manufacture of Sulphate of Ammonia for a period of One Year from the 1st day of May, 1898.

Form of Tender and Conditions may be obtained on application to the Engineer and Manager, Gas-Works, Bury.

Sealed Tenders, endorsed "Tender for Acid," to be sent to me, the undersigned, on or before Monday, the 25th of April, 1898.

JOHN HASLAM,
Town Clerk.

Corporation Offices, Bury,
April 7, 1898.

TENDERS FOR GAS COAL.

THE Directors of the Watford Gas and Coke Company invite TENDERS for the supply during the Twelve Months, from the 1st day of July, 1898, to the 30th day of June, 1899, of 10,000 Tons (more or less) of GAS COAL (screened or unscreened), to be delivered at the Bushey Station of the London and North-Western Railway.

Forms of Tender and Information may be obtained on application (in writing only) of me the undersigned.

Tenders to be delivered on or before the 6th day of May, 1898, addressed to the Chairman of the Watford Gas and Coke Company, Watford, endorsed "Tender for Gas Coal."

Tenders must be on the form supplied, any alteration of which will invalidate the Tender.

The Directors do not bind themselves to accept any Tender.

WILLIAM ROWELL,
Secretary.

Watford Gas and Coke Company's Offices,
Watford, April 16, 1898.

CORPORATION OF BLACKPOOL.

THE Gas Committee are prepared to receive TENDERS for the making of a BRICK and PUDDLE GASHOLDER TANK, 152 feet diameter on the present Gas-Works Site.

Plans, Specifications, and Conditions may be seen at the Office of the undersigned.

Tenders, endorsed, must be sent to the Chairman not later than the 25th of April.

The lowest Tender not necessarily accepted.

(Signed) JOHN CHEW,
Gas Engineer.

Gas Office, Princess Street,
Blackpool, April 6, 1898.

BOROUGH OF ROCHDALE.

SUPPLY OF PETROLEUM SPIRIT.

THE Gas Committee of the above Corporation invite TENDERS for the supply of about 40,000 Gallons of CARBURINE (sp. gr. ·680), to be delivered during a period of Six Months from Oct. 1, 1898.

Forms of Tender may be obtained on application to Mr. T. Banbury Ball, the Manager at the Gas-Works.

Tenders, endorsed "Carburine," must be sent in to me not later than Noon on Wednesday, April 27, 1898.

By order,
JAMES LEACH,
Town Clerk.

Town Hall, Rochdale,
April 14, 1898.

SALES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS begs to notify that his AUCTIONS of STOCKS and SHARES in London, Suburban, and Provincial Gas and Water Companies are held MONTHLY, at the Mart, Tokenhouse Yard, E.C.

He also undertakes the issuing by Auction of Gas and Water Stocks and Shares under Parliamentary Powers.

Terms for issuing such Capital, and also for including Gas and Water Stocks and Shares in these periodical Sales, can be obtained on application at Mr. Alfred Richards's Offices, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the

SOUTHEND WATER-WORKS COMPANY AND OTHER OWNERS.

MR. ALFRED RICHARDS will Sell BY AUCTION, at the Mart, E.C., on Wednesday, May 11, at Two o'clock, in Lots:—

500 £10 SHARES in the SOUTHEND WATER-WORKS COMPANY; also SHARES in the WEST HAM GAS COMPANY, CHIGWELL, LOUGHTON, and WOODFORD GAS COMPANY, and EPPING GAS COMPANY.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

THE ST. NEOT'S WATER COMPANY.

Incorporated by the St. Neot's Water Act, 1897.

CAPITAL - - £9000.

ISSUE OF 900 ORDINARY SHARES OF £10 EACH.

The Liability on the Shares is limited to £10 per Share.

Under Section 75 of the Water-Works Clauses Act, 1847, the Shares may rank for Dividends up to 10 per cent.

Price of Issue par.

BANKERS: Messrs. BARCLAY & COMPANY, LTD., St. Neot's; Head Office, 54, Lombard St., London, E.C.; and Branches.

The LIST will OPEN on MONDAY, April 18, and will CLOSE on or before SATURDAY, April 23, 1898.

Payments: On application, 20 per cent.; and balance in calls of 20 per cent. at intervals of not less than two months.

By the St. Neot's Water Act, 1897, which received the Royal Assent on the 15th day of July, 1897, the Company were incorporated and empowered to construct water-works and supply water within the town of St. Neot's and the parishes of St. Neot's Rural and Eynesbury-Hardwicke.

The important town of St. Neot's, with a population of about 4000, has no public water supply, which for sanitary and other purposes is urgently wanted. The town is situated on a gravel bed in the valley of the River Ouse. The only supply at present is from wells sunk in this gravel, many of which have been condemned as unwholesome. There is at present no sewerage scheme for the town. There are two breweries in the town and a firm of mineral water manufacturers. The latter obtain most of their water supply by vans from a spring in Bedfordshire, at a cost which may be estimated at about £60 per annum.

The population to be supplied under the powers conferred upon the Company is about 5000; and inasmuch as the present water supply has been over and over again condemned, there is no doubt that within a short period the whole of the district will take their supply from the Company.

An excellent site has been secured at some distance away from the town for sinking the necessary wells and constructing filter pipes or tunnels, as in the case of the neighbouring towns of Bedford and Huntingdon; and the water will be pumped to a service reservoir on high ground near by, and thence supplied to the town by gravitation. At a recent local inquiry held by the Board of Trade as to the proposed site, no opposition was offered.

The rates allowed by the St. Neot's Water Act are liberal, and compare very favourably with those of other Companies. The authorized charge for water supplied by meter for public purposes is 1s.; and for other consumers 1s. 6d. per 1000 gallons. It will be seen from the sketch map enclosed with the Prospectus that the town is very compact, and that the scheme is a very simple one.

An estimate of the probable revenue has been made; and the Directors are confident that, in a few years, the maximum dividend (limited under the Company's Act to 10 per cent.) will be paid. Pending completion of the works, interest at the rate of 3½ per cent. is guaranteed for the first year; and this sum will be deposited in Consols for this purpose.

The whole of the land required for works, with the necessary easement for pipes leading to the reservoir, has been arranged for by private contract; and an agreement for purchase has been signed.

The works are designed for the supply of 100,000 gallons daily, being an estimated consumption of 20 gallons per head for a population of 4000 and 20,000 additional for trade and other purposes; but the supply can, however, be materially increased if found necessary.

The contract for the construction of the works has been placed with the well-known firm of Messrs. Thomas Docwra and Sons, of Ball's Pond, Islington; the engines will be supplied by Messrs. Richard Hornsby, Sons, and Co.; and the pumps, by Messrs. Frank Pearn and Co., of Manchester. The works will be commenced at once; and it is anticipated that the Company will be supplying the town by the end of the present year.

The Urban Council of St. Neot's have power to purchase the undertaking of the Company within a period of two years after the completion of the works; but it is upon the express condition that the price to be paid shall not be less than the sum reasonably expended by the Company; and the price is to be settled by arbitration under the Lands Clauses Acts, which carries with it a sum of 10 per cent. for compulsory purchase.

The dividends of the following Water Companies in towns of about the same population as St. Neot's show the profitable nature of such investments when working under the protection of a Special Act of Parliament:—

Name of Company.	Population Supplied.	Dividend Paid. Per Cent.
Brightlingsea Water Company	4000	7½
Carnforth Water Company	3000	7
Daventry Water Company	4000	10
Dolgelly Water Company	3500	8
Malmesbury Water Company	4000	10
Royston Water Company	4000	8
Wells Water Company	4519	9

A Form of Application for Shares is enclosed with the Prospectus. Where no allotment is made, the deposit will be returned in full; and in case of a partial allotment, the balance of the deposit will be applied towards the subsequent instalments. If default be made in payment of any instalment at its proper date, the deposit and instalments previously paid will be liable to forfeiture.

Prospectuses and Forms of Application may be obtained at the Company's Offices; or of their Bankers, Messrs. Barclay and Co., Limited, St. Neot's; Head Office, 54, Lombard Street, London, E.C., and Branches; of Messrs. Addyman and Evans, 15, East Parade, Leeds; or Messrs. Baker, Lees, and Co., Solicitors, 22, Great George Street, Westminster, at whose Office the before-mentioned Contract and copy of the Company's Act can be inspected.

Applications for Shares to be made on the form enclosed with the Prospectus and forwarded to the Company's Bankers with the amount of deposit.

DIRECTORS:

Col. MACNAGHTEN, The Briars, Shortlands, Kent.
THOS. ADDYMAN, Esq., West Gorton, Manchester.
CHARLES H. BINNEY, Esq., 4, Tavistock Road, Westbourne Park.
* It is proposed to appoint two local Directors after allotment.

BANKERS: Messrs. BARCLAY & CO., LTD., St. Neot's.
COMPANY'S OFFICES: 22, Great George St., Westminster.
April, 1898.

GUILDFORD GASLIGHT AND COKE COMPANY.

THE Directors of the above Company are prepared to receive TENDERS for the supply and erection of a modern and effective BOILER FEED WATER HEATER (7-inch Connections) on their Works.

Tenders to be sent in to the Chairman of the Company on or before Friday, April 22, at Ten a.m.

WILLIAM TITLEY,
Secretary.

CONTRACT FOR COAL.

THE Directors of the Rickmansworth Gas Company are prepared to receive TENDERS for the supply of 400 to 1400 Tons of SOUTH YORKSHIRE Screened SILKSTONE NUTS, delivered at the Metropolitan Station, Rickmansworth, Herts.

Tenders to be sent in to the undersigned not later than the 28th inst.

HENRY HILL,
Manager, &c.

PUBLIC SALE
ON MAY 10 AND 11,
OF A
COAL-TAR DISTILLERY
SITUATED AT AMSTERDAM.

THESE Works are completely arranged for the distillation and working up from 10,000 to 15,000 Tons of Coal Tar, and are capable of a further enlargement to 20,000 Tons a year.

They are situated on the Wetering Canal between the Amstel and the Y, and are accessible for Ships and Barges with a draught of about 8 feet.

The Superficial Area is about 15,000 square metres, very favourably situated within the limits of the Commune of Amsterdam.

For further Information, inquiries to be addressed to THE SOCIETY OF CHEMICAL INDUSTRY, Frederiksplein 5, AMSTERDAM.

During the Year 1898, Contracts are open at different Gas-Works in Holland for a quantity of about 16,000 Tons.

Creosote Oil for the preparation of Timber, much employed in this country, is protected by an import duty of fl.5 per ton.

N.B.—About 9000 additional square metres of Land adjoining can also be purchased.

Price 6s., Cloth Bound,

THE CHEMISTRY OF ILLUMINATING GAS.

By N. H. HUMPHRYS, Assoc M.Inst.C.E., F.C.S.

LONDON: Walter King, 11, Bolt Court, Fleet St., E.C.

Will be Published in a few Days,

A NATIONAL SONG
BY
A. C. FRASER, Gas Engineer, Neasden, N.W.
(formerly Gas Manager, Bolton).

Words and Music are bright and cheery.

Copy sent Free by Post for 1s. 6d.

APPLY TO THE ABOVE ADDRESS.

PRICE'S COKE & COAL BARROW

effects a great saving of time, labour, and expense.

For Particulars, Price, &c., apply to Mr. EDWARD PRICE, 119, Queen's Road, FINSBURY PARK, N.

Prices are Reduced.

COKE-BREAKERS,

PRICES REDUCED.

(THOMAS & SOMERVILLE'S PATENT)

With Elevators and Conveyors worked by Steam or Gas Engine.

GEORGE WALLER & CO.,
165, QUEEN VICTORIA STREET, E.C.
And at STROUD, GLOUCESTERSHIRE.

UNEQUALLED.

Gas Companies are solicited to try Samples of the

MIRFIELD
BLACK BED GAS COAL.

Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

THOMAS DUXBURY & CO.,
16, DEANSGATE, MANCHESTER.

Best Gas Coal and Cannel, giving High Illuminating Power, Large Yield per ton, and reasonable in Price.

Telegrams: "DARWINIAN, MANCHESTER."
Telephone 1806.

GAS PURIFICATION BY
HYDRATED OXIDE.

THIS Material is of full Strength, and Exceptional Activity. It is specially prepared to minimize Back-Pressure; and will be supplied on Hire, or Sold, on the most favourable Terms.

SPENT OXIDES containing Blue, also CRUDE FERRO-CYANIDE PRODUCTS, either PURCHASED or EXCHANGED for FRESH OXIDE.

MANCHESTER OXIDE COMPANY, LTD.,
CANAL ST., MILES PLATTING, MANCHESTER.

THOMAS TURTON
AND SONS, LIMITED,
SHEAF WORKS, SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES,
SPANNERS, RATCHET BRACES, LIFTING JACKS,
ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.
LONDON OFFICE:
90, CANNON STREET, E.C.

HOLMSIDE
GAS COALS.

Present Daily Produce over 5000 Tons.

Latest Analysis—By CHARLES PHILLIPS, Gas Examiner to Rotherham Corporation

Yield of Gas per Ton . . .	11,205 Cubic Feet.
Illuminating Power	$16\frac{7}{10}$ Stand. Sperm. Candl.
Coke (of good & pure quality)	$13\frac{3}{4}$ Cwt. per Ton.
Sulphur	A little over 1 per Cent.
Ash	Under 1 per Cent.
Tar	163 lbs. (Avoir.) per Ton.
Ammoniacal Liquor	103 lbs. (Avoir.) per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR
PELTON GAS COALS.

Present Daily Produce available 3000 Tons.

Of equal quality to the "Holmside" Coal, and also very largely used by many Gas Companies at Home and Abroad.

Both descriptions are shipped at Tyne Docks, and Dunston Staiths, River Tyne, also at North and South Docks, Sunderland.

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,
HOLMSIDE & SOUTH MOOR OFFICES,
NEWCASTLE-UPON-TYNE.

Ready this Day—450 Pages, Crown 8vo., with numerous Illustrations, 10s. 6d. Leather.

THE
GAS ENGINEER'S
POCKET BOOK,

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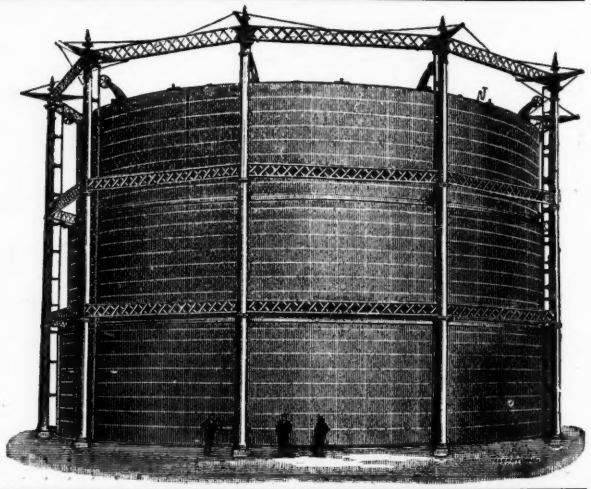

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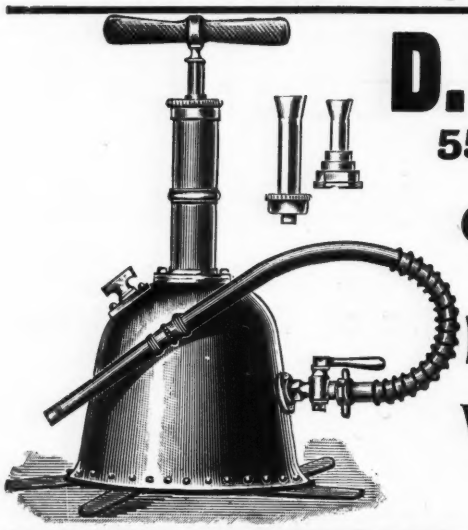

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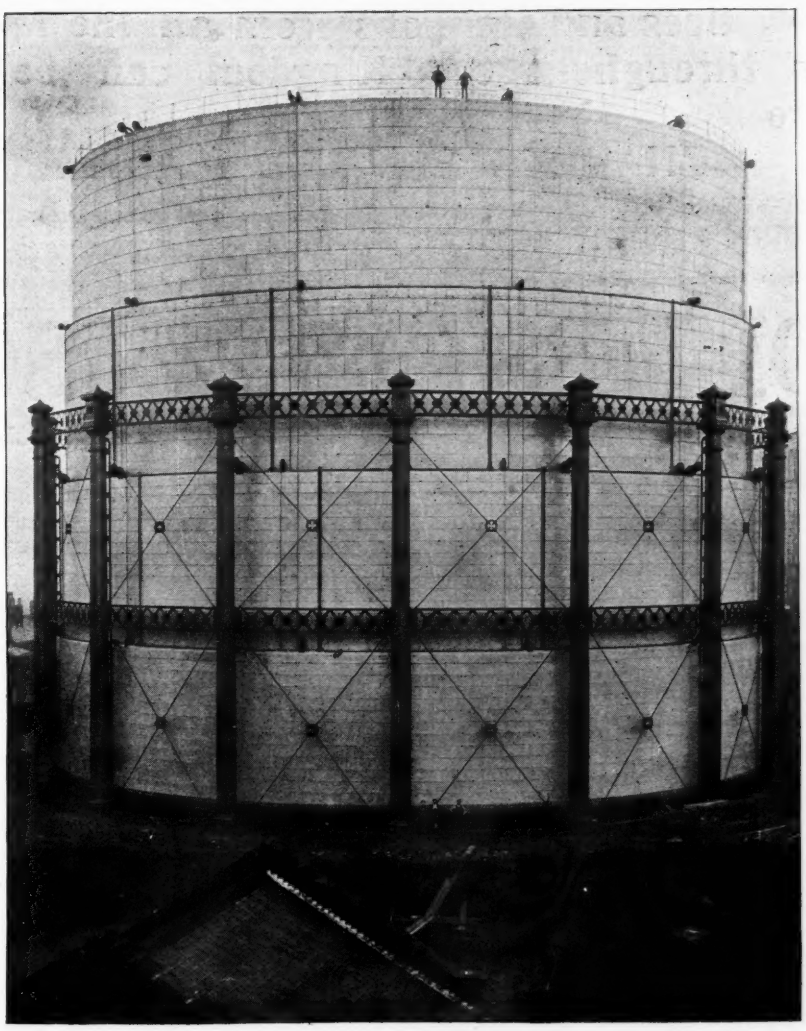

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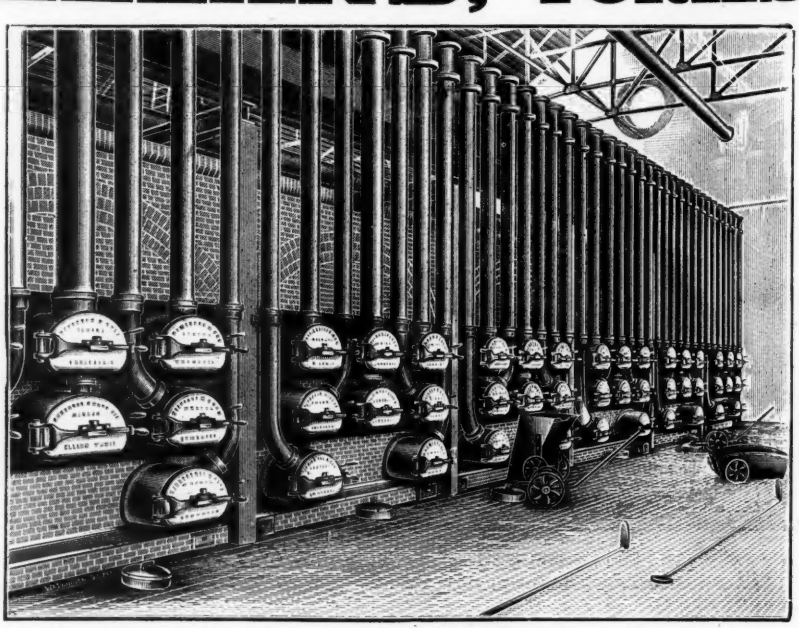

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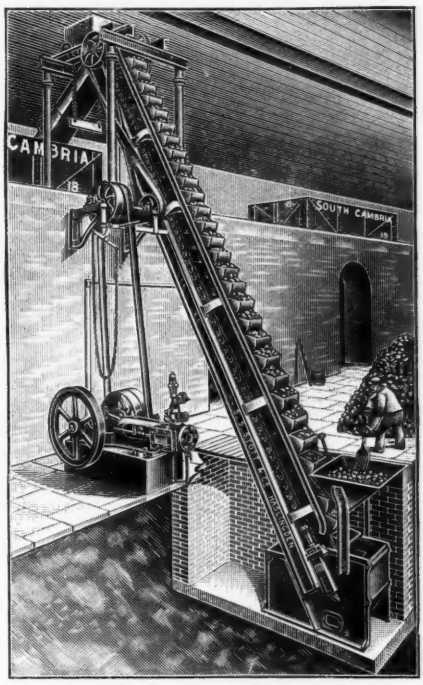

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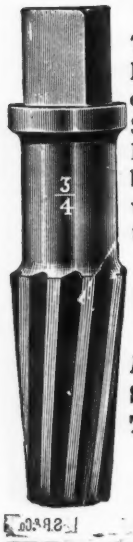

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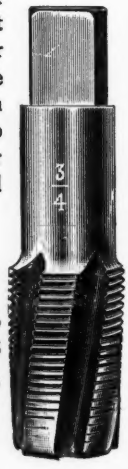

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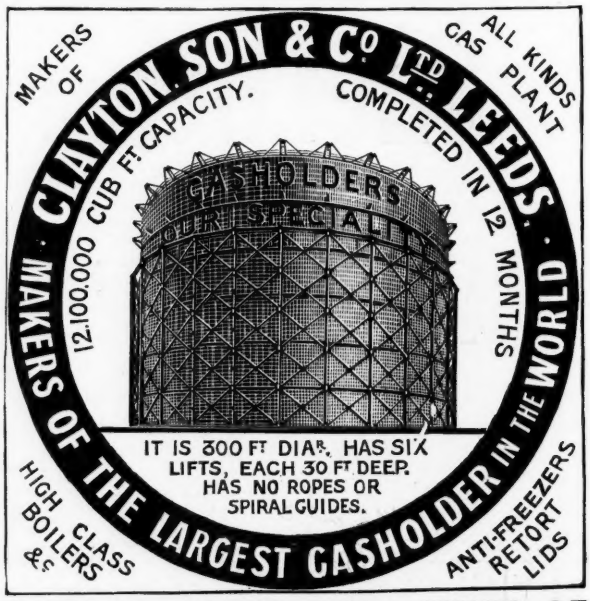
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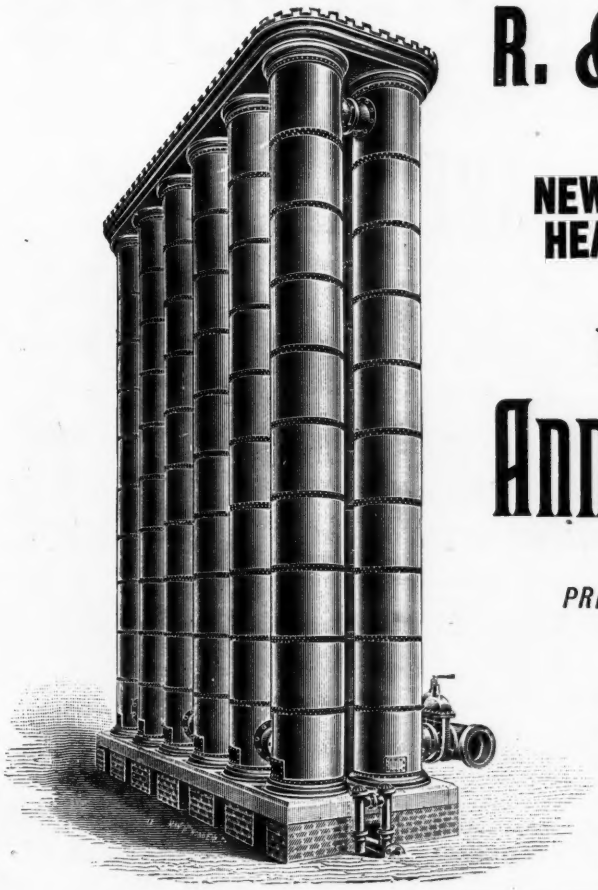

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